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**U.S. Department of the Interior**
**Bureau of Land Management**

Eugene District Office
P.O. Box 10226
Eugene, Oregon 97440-2226

**July 2003**

# Draft Environmental Impact Statement Upper Siuslaw Late-Successional Reserve Restoration Plan

*Lane and Douglas Counties, Oregon*

COMPLETE

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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# ABSTRACT

The BLM, in cooperation with the U.S. Fish and Wildlife Service, proposes to adopt and implement a forest and aquatic ecosystem restoration plan for BLM-administered lands within a Late-Successional Reserve (LSR) in the Coast Range Mountains west of Eugene, Oregon. The plan will provide a 10-year management approach and specific actions needed to achieve the LSR goals and Aquatic Conservation Strategy objectives set out in the Eugene District Resource Management Plan and the Northwest Forest Plan. The purpose of the action is to:

- protect and enhance late-successional and old-growth forest ecosystems;
- foster the development of late-successional forest structure and composition in plantations and young forests; and
- reconnect streams and reconnect stream channels to their riparian zones and upslope areas.

The Draft EIS analyzes six alternatives, designed to represent different overall management approaches to restoration:

Alternative A- No Action;
Alternative B - plantation and road management with no timber harvest;
Alternative C - continue current management approach;
Alternative D - threatened and endangered species recovery;
Alternative E - reduce stand densities as quickly as possible;
Alternative F - multi-entry and multi-trajectory thinning.

The preferred alternative is Alternative D.

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MARCH 3, 1849

**United States Department of the Interior**

**BUREAU OF LAND MANAGEMENT**
Eugene District Office
P.O. Box 10226
Eugene, OR 97440-2226

In Reply Refer To:
1736A

Dear Reader:

Thank you for your interest in the proposed Upper Siuslaw Late-Successional Reserve Restoration Plan. Please find enclosed a Draft Environmental Impact Statement (EIS) analyzing the impacts of alternative restoration plans. The Bureau of Land Management is the lead agency for this Draft EIS, and the Fish and Wildlife Service is a cooperating agency. I would appreciate your comments on this Draft EIS. Comments should be as specific as possible, and address the adequacy of the EIS or the merits of the alternatives discussed, or both. To enable us to analyze and use fully all information acquired during the review of this Draft EIS, reviewers need to provide their comments during the established 60-day review period. Comments on the Draft EIS must be submitted in writing by October 15, 2003, to me at:

Bureau of Land Management
Eugene District
P.O. Box 10226
Eugene, OR 97440-2226
or by e-mail at or090mb@or.blm.gov Attn: Rick Colvin.

Comments, including names and street addresses of respondents, will be available for public review at the Eugene District office during regular hours (7:45 a.m. to 4:15 p.m.), Monday through Friday, except holidays, and may be published as part of the environmental analysis or other related documents. Individual respondents may request confidentiality. If you wish to withhold your name or address from public review or from disclosure under the Freedom of Information Act, you must state this prominently at the beginning of your written comment. Such requests will be honored to the extent allowed by law. All submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organization or businesses, will be made available for public inspection in their entirety.

Questions concerning this Draft EIS may be directed to Pick Colvin, LSR Restoration Team Leader, at the address above, by telephone at (541) 683-6600 or (1-888) 442-3061, or by e-mail at or090mb@or.blm.gov Attn: Rick Colvin. I appreciate your interest in the management of these public lands.

Sincerely,

Steven Calish

Steven Calish
Field Manager, Siuslaw Resource Area

Enclosure
(Draft EIS)

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# Executive Summary

## Introduction

This Environmental Impact Statement (EIS) analyzes alternatives for a plan for forest and aquatic ecosystem restoration within a Late-Successional Reserve (LSR 267) in the Coast Range Mountains, west of Eugene, Oregon. The proposed plan would be a 10-year management approach and contain specific actions needed to achieve the LSR goals and Aquatic Conservation Strategy objectives set out in the Northwest Forest Plan.

LSR 267 lies almost entirely within the Siuslaw River basin in the Oregon Coast Province, with a very small portion in the Umpqua River basin. The portion of LSR 267 addressed by this proposed restoration plan encompasses 24,400 acres of BLM-managed land. The planning area extends from the eastern edge of LSR 267, just west of the Lorane Valley, to Oxbow Creek. The northern boundary is defined by the ridge between the Siuslaw and Wolf Creek watersheds. The southern boundary is defined by the boundary between the Eugene and Roseburg Districts, which approximates the ridge between the Siuslaw and Umpqua River basins.

## Purpose and Need

The purpose of the action is to:

- protect and enhance late-successional and old-growth forest ecosystems;
- foster the development of late-successional forest structure and composition in plantations and young forests; and
- reconnect streams and reconnect stream channels to their riparian zones and upslope areas.

This action will be developed consistent with the decisions of the *Eugene District Resource Management Plan* (RMP) and will address the recommendations of the *Late-Successional Reserve Assessment for the Oregon Coast Province - Southern Portion – RO267, RO268* (LSR Assessment) and the *Siuslaw Watershed Analysis*.

The need for the action is established in Final Supplemental Environmental Impact Statement (FSEIS) for the Northwest Forest Plan, the Eugene District RMP, the LSR Assessment, and the Siuslaw Watershed Analysis. These documents establish the need for forest and aquatic restoration in the planning area and the role of active management in restoration.

## Issues

The issues for analysis were developed based on public scoping, interdisciplinary team discussion, and agency staff comments. The issues are summarized below and serve to focus the analysis and comparison of alternatives.

1. *How would road decommissioning and road management actions alter public access to BLM lands?*

2. *How much new road construction would be needed to implement restoration actions?*
3. *What level of risk to existing late-successional forest would result from restoration activities?*
4. *How would thinning affect development of late-successional forest structural characteristics?*
5. *What are the effects of restoration activities on marbled murrelet habitat?*
6. *What are the effects of restoration activities on northern spotted owl habitat?*
7. *What are the effects of restoration activities on coho salmon habitat?*
8. *How would restoration activities affect the presence and spread of noxious weeds?*
9. *What would be the economic effects of restoration activities?*
10. *What are the costs of restoration?*

## Alternatives

This EIS analyzes six alternatives in detail: the No Action alternative and five action alternatives.

**Alternative A – No Action**
This alternative would take no management actions to achieve the purpose of the action. Only those management actions specifically required by the RMP or by law or policy would occur.

**Alternative B – Plantation and Road Management with No Timber Harvest**
Alternative B is designed to accomplish restoration without timber harvest. It would thin Douglas-fir plantations, but not unmanaged stands or any stands over 50 years old. No trees would be intentionally felled or pulled into streams, and no in-stream structures would be constructed. Alternative B would decommission all roads where legally possible and would not construct any new roads.

**Alternative C – Continue Current Management Approach**
Alternative C is designed to continue the current pace of restoration, using current silvicultural techniques and stream restoration strategies. Alternative C would decommission eroding roads and would construct new roads as needed.

**Alternative D – T&E Species Recovery**
Alternative D is designed to take advantage of restoration opportunities that would have the least short-term adverse effects with the most long-term benefits to habitat for northern spotted owls, marbled murrelets, and coho salmon. All commercial thinning would be completed within the next 10 years. Riparian stands would be thinned without timber removal. In-stream woody debris structures would be constructed, and some structures would be cabled for stability. Alternative D would decommission eroding roads and roads in or adjacent to late-successional forest. New road construction would be limited to short, temporary spur roads.

**Alternative E – Reduce Stand Densities as Quickly as Possible**
Alternative E is designed to achieve tree densities typical of local late-successional forests as soon as possible. All commercial thinning would be completed within the next 10 years. Trees would be felled or pulled into all streams adjacent to stands 80 years old, but woody debris would not be cabled for stability. Alternative E would decommission eroding roads and roads in or adjacent to late-successional forest. New roads would be constructed as needed.

**Alternative F – Multi-entry and Multi-trajectory Thinning**
Alternative F is designed to accomplish restoration using multiple thinning of stands to maintain stand vigor and develop stand stability while maintaining canopy closure. In-stream woody debris structures would be constructed on larger streams, and some would be cabled for stability. Alternative F would decommission eroding roads and roads in late-successional forest and would construct new roads as needed.

## Preferred Alternative

Alternative D is the BLM preferred alternative, because it would:

- effectively foster the development of late-successional forest structure;
- thin stands to a wide range of stand densities, which would maintain future management options;
- maintain the current amount of dispersal habitat for northern spotted owls;
- decommission the most damaging roads;
- moderate the risk of wildfire over time; and
- generate revenue greater than the costs, indicating the feasibility of implementing the overall restoration program.

## Environmental Consequences

The effects of the alternatives differ most notably for the effects on the road system, the attainment of late-successional structure, northern spotted owl dispersal habitat, and the economic costs and revenues. The risk to existing late-successional forest and the effects on coho habitat are substantially similar for all action alternatives, but the effects of action alternatives differ substantially from the No Action alternative. The effects of the alternatives on marbled murrelet habitat parallel the effects on the attainment of late-successional structure. The effects of the alternatives on noxious weeds are directly tied to the effects on the road system.

**Alternative A (No Action)** would leave the existing road system intact and would generate no economic activity. Alternative A would pose a high risk of catastrophic fire, because almost all young stands would go through a prolonged period of stand stagnation. Stands currently 40 years old would quickly become spotted owl dispersal habitat, but would not attain late-successional structure within the 100-year analysis period. Alternative A would produce the most chronic sedimentation to streams and would pose a high risk of catastrophic sedimentation from culvert failures.

**Alternative B** would decommission the greatest length of roads and build no new roads. It would not slow the development of spotted owl dispersal habitat. It would have limited effectiveness in speeding the attainment of late-successional forest structure. It would have no revenue and moderate costs.

**Alternative C** would decommission a short length of roads and would build a moderate length of new roads. It would not slow the development of spotted owl dispersal habitat. It would not effectively speed the attainment of late-successional structure. The revenues would be slightly lower than the costs.

**Alternative D** would decommission a moderate length of roads and would build a small length of new roads. It would slow the development of spotted owl dispersal habitat (although it would always maintain the current amount). It would effectively speed the attainment of late-successional structure. The moderate revenues would exceed the costs.

**Alternative E** would decommission a moderate length of roads, but would build the greatest length of roads. It would slow the development of spotted owl dispersal habitat (and temporarily reduce it below the current amount). It would be the most effective at speeding the attainment of late-successional structure. It would generate the most economic activity and would have the highest revenues, which would substantially exceed the costs.

**Alternative F** would decommission a short length of roads and build a considerable length of new roads. It would not slow the development of spotted owl dispersal habitat. It would have limited effectiveness in speeding the attainment of late-successional forest structure. It would generate almost as much economic activity as Alternative E, and the revenues would substantially exceed the costs.

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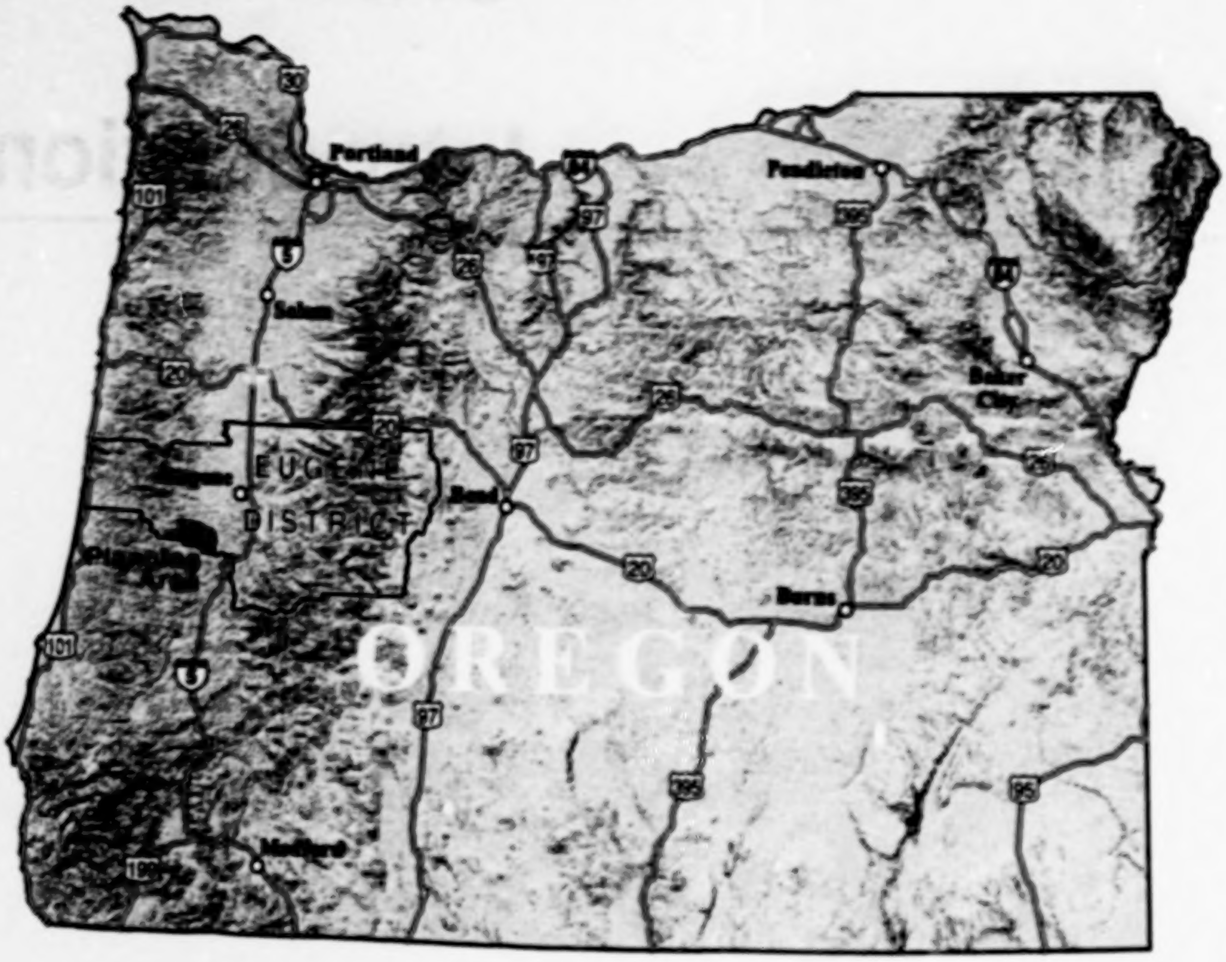
# CHAPTER 1

# Introduction



U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management

**EUGENE DISTRICT**
**Upper Siuslaw**
**Late-Successional Reserve**
**Restoration Plan**
**2003**

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Location of the Upper Siuslaw Late-Successional Reserve Restoration Planning Area

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# Introduction

This Environmental Impact Statement (EIS) analyzes alternatives for a plan for forest and aquatic ecosystem restoration within a Late-Successional Reserve (LSR 267) in the upper portion of the Siuslaw River Watershed in the Coast Range Mountains, west of Eugene, Oregon. The proposed plan would be a 10-year management approach and contain specific actions needed to achieve the LSR goals and Aquatic Conservation Strategy objectives set out in the Northwest Forest Plan.

The National Environmental Policy Act (NEPA) of 1969, as amended, requires Federal agencies to consider environmental consequences in their decision-making process. The Council on Environmental Quality (CEQ) has issued regulations to implement NEPA that include provisions for both the content and procedural aspects of the required environmental analysis (40 CFR 1500). The environmental impact analysis process, as governed by the Department of the Interior Departmental Manual 516, *NEPA Compliance*, and BLM Manual H-1790-1, *National Environmental Policy Act Handbook*, is the mechanism by which BLM ensures its decisions are based on an understanding of potential environmental consequences. Preparation of this EIS must precede a final decision regarding the selection of an alternative, and must be available to inform the decision-maker and the public of potential environmental consequences. The development of this EIS allows for public consideration and input concerning the proposed restoration plan, and will provide to the decision maker and the public the information required to understand the future environmental consequences of the alternatives. After completion of this EIS, BLM will issue a Record of Decision which will select the alternative that will be implemented.

# Background

The Northwest Forest Plan created a network of LSRs to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species, including the northern spotted owl. These reserves are designed to maintain a functional, interacting, late-successional and old-growth forest ecosystem (USDA and USDI, April 1994, pp. C-9 - C-11). The Northwest Forest Plan directs that a management assessment be prepared for each LSR before habitat manipulation activities are designed and implemented (USDA and USDI, April 1994, p. C-11). BLM and the Forest Service prepared an LSR Assessment for LSR 267 in 1997 (USDA and USDI 1997).

The Northwest Forest Plan also developed an Aquatic Conservation Strategy to restore and maintain the ecological health of watersheds and aquatic ecosystems. One component of the Aquatic Conservation Strategy is a network of Riparian Reserves along rivers, streams, and other hydrologic features. Riparian Reserves are portions of watersheds where riparian-dependent and stream resources receive primary emphasis (USDA and USDI, April 1994, pp. B-12 - B-17). The Northwest Forest Plan directs that a watershed analysis be prepared to serve as a basis for project proposals, and monitoring and restoration needs for a watershed (USDA and USDI, April 1994, pp. B-20 - B-21). BLM prepared a watershed analysis for the Siuslaw River Watershed in 1996 (USDI BLM 1996a).

The network of Riparian Reserves overlap the LSRs. The Northwest Forest Plan explains that these overlapping land use allocations work together:

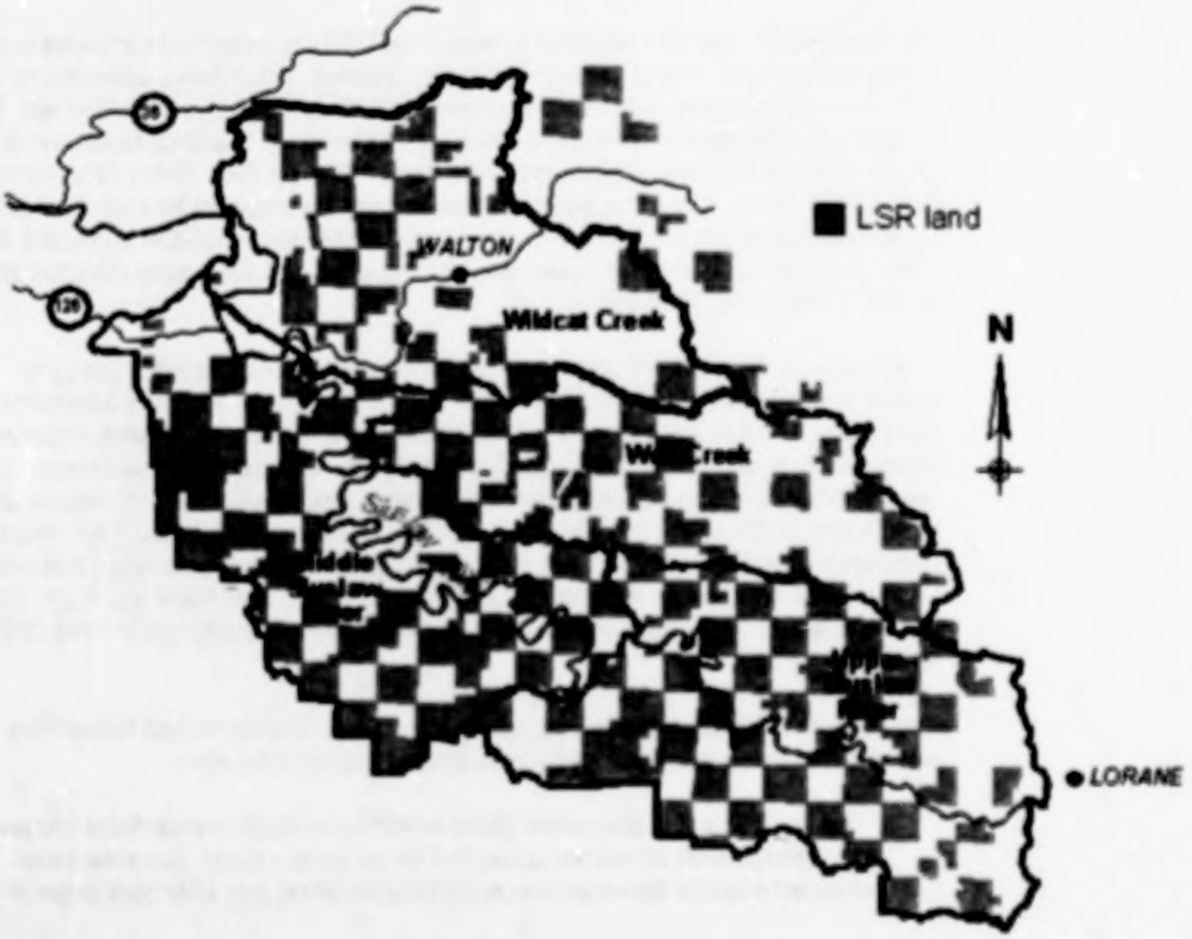
> *"The standards and guidelines under which Late-Successional Reserves are managed provide increased protection for all stream types. Because these reserves possess late-successional characteristics, they offer core areas of*

*high quality stream habitat that will act as refugia and centers from which degraded areas can be recolonized as they recover." (USDA and USDI, April 1994, p. B-12).*

## General Location

LSR 267 lies almost entirely within the Siuslaw River basin in the Oregon Coast Province, with a very small portion in the Umpqua River basin. LSR 267 includes 175,280 acres of federal land managed by the BLM Eugene, Roseburg, and Coos Bay Districts and the Siuslaw National Forest (see Map 6). The Eugene District manages approximately 83,000 acres (47%) of LSR 267. Of this total acreage, 24,400 acres are within the Upper Siuslaw River sub-unit (14% of LSR 267), which will be addressed by this restoration plan. BLM hopes to develop similar restoration plans in the future for the other sub-units of LSR 267: Middle Siuslaw River, Wolf Creek, and Wildcat Creek (see Figure 1).

The area of this proposed restoration plan, the Upper Siuslaw River sub-unit of LSR 267, extends from the eastern edge of LSR 267, just west of the Lorane Valley. The Upper Siuslaw sub-unit extends west to Oxbow Creek (see Map 6). The northern boundary is defined by the ridge between the Siuslaw and Wolf Creek watersheds. The southern boundary is defined by the boundary between the Eugene and Roseburg Districts, which approximates the ridge between the Siuslaw and Umpqua River basins (although a very small portion of the Upper Siuslaw sub-unit of LSR 267 extends into the Umpqua River basin). This area will be referred to hereafter as "the planning area" and encompasses only the BLM-managed Late-Successional Reserves within the above boundaries. Many of the graphs and tables in this EIS address only the portion of the planning area that is ≤80 years old (13,800 acres).



# Purpose and Need

The purpose of the action is to:

- protect and enhance late-successional and old-growth forest ecosystems;
- foster the development of late-successional forest structure and composition in plantations and young forests; and
- reconnect streams and reconnect stream channels to their riparian zones and upslope areas.

This action will be consistent with the decisions of the *Eugene District Resource Management Plan* (RMP) and will address the recommendations of the *Late-Successional Reserve Assessment for the Oregon Coast Province - Southern Portion – RO267, RO268* (LSR Assessment) and the *Siuslaw Watershed Analysis.*

The need for the action is established in the FSEIS for the Northwest Forest Plan, which concludes that young plantations are unlikely to follow natural stand development pathways toward late-successional conditions if left untreated; that the loss of in-stream large woody debris has reduced aquatic habitat complexity; and that badly designed or damaged roads and culverts are degrading aquatic habitat quality (USDA and USDI February 1994, pp. 3&4-49, 3&4-54, 3&4-59).

The need for the action is also established in the Eugene District RMP, which directs that we restore and maintain the ecological health of watersheds and aquatic ecosystems (USDI BLM 1995, p. 18); that we plan and implement LSR projects that are beneficial to the creation of late-successional habitat; and that we improve conditions for fish, wildlife, and watersheds (USDI BLM 1995, pp. 30-31).

The need for the action is also established in the LSR Assessment, which defines management triggers, criteria, and appropriate activities within the LSR (USDA and USDI 1997, pp. 42-46). The LSR Assessment explains:

> *"Dense uniform conifer stands in managed plantations (25-50 years) will be the primary focus for manipulating vegetation to provide the structural conditions associated with late-successional characteristics. Although dense, uniform stands have been a part of the landscape, the amount and distribution of these stands now occurring in these LSRs is inconsistent with the range of natural conditions."* (USDA and USDI 1997, p. 36).
>
> *"The overall goal for management of the LSR is to protect, maintain, and create late-successional forest ecosystems which serve as habitat for late-successional and old-growth related species. Management treatments will strive to re-establish connectivity of that habitat in the least amount of time to maintain functional, interacting late-successional forest ecosystems"* (USDA and USDI 1997, p. 47).

The need for the action is also established in the Siuslaw Watershed Analysis, which includes a series of recommendations relevant to LSR management:

- silvicultural practices in the Riparian Reserves to accelerate development of large green trees, snags and coarse woody debris, multi-layered canopies, and increased

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tree species diversity, and to restore large conifers where past management practices have resulted in hardwood-dominated riparian stands;

- thinning conifer stands to accelerate the development of large trees, killing trees to make snags and coarse woody debris, creating gaps and leaving understory trees to develop a multi-layer canopy, underplanting to develop a multi-storied canopy, and favoring species other than Douglas-fir, if available, to increase species diversity;
- creation of in-stream structures in the Siuslaw River and tributaries to improve aquatic habitat and hydrologic function;
- examination and replacement as needed of existing culverts to improve aquatic habitat and hydrologic function;
- road decommissioning or closure to improve terrestrial wildlife habitat, especially for elk (although the watershed analysis concludes that there is limited opportunity to reduce stream sedimentation by road decommissioning); and
- an integrated noxious weed control program to reduce noxious weed populations below levels that impair the viability of native species (USDI BLM 1996a, Chapter V, pp. 1-6).

Finally, the watershed analysis recommends:

> *"The next logical step toward ecosystem management in the Siuslaw Watershed is to look at ecosystem planning on a watershed scale. Such an endeavor could develop management for this geographic area in a way that ensures the biological integrity and sustainability of the Siuslaw Watershed."* (USDI BLM 1996a, Chapter V, p. 6).

## Cooperating Agency

The U.S. Fish and Wildlife Service (FWS) is a cooperating agency in the preparation of this EIS because of their special expertise in threatened and endangered species: specifically here, the northern spotted owl and marbled murrelet. The FWS has been a part of the EIS interdisciplinary team (see Chapter 5) and has participated in the scoping process, the development of the alternatives, and the analysis of the environmental impacts.

## Relationship to Policies, Plans, and Programs

All alternatives are in conformance with the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl* (Northwest Forest Plan) (USDA Forest Service and USDI Bureau of Land Management, April 1994), and the *Eugene District Resource Management Plan* (RMP), as amended by the *Record of Decision for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* (USDA Forest Service and USDI Bureau of Land Management, January 2001). Under all alternatives, Survey and Manage surveys would be conducted as required consistent with survey protocols applicable at the time of the action, and known sites of Survey and Manage species would be managed consistent with the Management Recommendations applicable at the time of the action.

The Siuslaw River, which runs through the planning area, has been identified by the Oregon Department of Environmental Quality (ODEQ) as a "Water Quality Limited

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Stream" for temperature and dissolved oxygen on its Draft 2002 303(d) list (Oregon Department of Environmental Quality 2003a, p. 117). Section 303(d) of the Clean Water Act requires each state to identify those waters which do not meet the state's water quality standards. BLM is a Designated Management Agency (DMA) with responsibility for maintaining the quality of waters on the 303(d) list that flow across the lands it manages. BLM will complete a Water Quality Restoration Plan (WQRP) in conjunction with the selected alternative. We will develop a water quality restoration plan in conjunction with the Record of Decision.

Possible conflicts between the alternatives and the objectives of other Federal, regional, State, and local land use plans, policies and controls are addressed in Chapter 4.

## Authorizing Actions and Implementation

Most actions contemplated in the alternatives are entirely within the authority of BLM and require no additional authorization or permit. However, ODEQ water quality standards are applicable to many aquatic restoration projects, which may require permits prior to implementation.

All of the action alternatives in this EIS are designed to implement decisions in the Eugene District RMP and would not require any RMP revision or amendment for adoption. This EIS is intended to analyze actions in sufficient detail so that we could implement many of the actions without additional NEPA analysis, following an eventual Record of Decision on the restoration plan. We would implement each management action (or group of related actions) under the eventual restoration plan with its own Decision Record, prior to which we would conduct a "Documentation of Land Use Plan Conformance and NEPA Adequacy" (DNA) to determine whether additional NEPA analysis is necessary. The DNA itself is not a NEPA document, but is merely an interim step in the BLM internal analysis process. More information on DNAs can be found in BLM Instruction Memorandum No. 2001-062, which is available online at http://www.blm.gov/nhp/efoia/wo/fy01/im2001-062.html.

Where site-specific conditions differ or circumstances change from those described in this EIS, or if a DNA is inappropriate for other reasons, we may need to conduct additional NEPA analysis prior to reaching a decision to implement a management action. For example, replacement of a culvert with an unusually large amount of fill might require an Environmental Assessment (EA) to consider effects of sedimentation that might exceed that analyzed in this EIS, which used approximate averages (see Chapter 4, Issue 7). As another example, stand-specific conditions – such as extensive windstorm damage or root rot – might suggest a stand-specific thinning prescription different from those in the selected alternative. However, such instances are expected to be the exception. The eventual Record of Decision on the restoration plan will address the DNA process and the need for future NEPA analyses in the broader discussion of implementation of the selected alternative.

Decision Records for projects implemented under this restoration plan would include descriptions of the Best Management Practices and project design features that we would implement. In some alternatives, we would consistently employ certain Best Management Practices for certain types of actions; in those instances, we have incorporated the management practices into the description of the alternative as guidelines or mitigation measures (see Appendix A).

The Record of Decision for the restoration plan will include a monitoring plan and a discussion of adaptive management for implementation of the selected alternative. The monitoring plan will describe how we will evaluate whether the projects implemented are within the scope of the restoration plan, whether their impacts are within the scope of the EIS, and whether the projects are achieving the anticipated results. The Record of Decision will also address how changes might be made through an adaptive management process based on monitoring results and changes in environmental conditions. We are not addressing monitoring and adaptive management here, because we will need to tailor the monitoring plan to a specific alternative, which will not be possible until the Record of Decision documents the selection of an alternative.

# Issues

We developed the issues for analysis based on public scoping, interdisciplinary team discussion, and agency staff comments. The issues are summarized below and serve to focus the analysis and comparison of alternatives.

1. *How would road decommissioning and road management actions alter public access to BLM-managed lands?*
2. *How much new road construction would be needed to implement restoration actions?*
3. *What level of risk to existing late-successional forest would result from restoration activities?*
4. *How would thinning affect development of late-successional forest structural characteristics?*
5. *What are the effects of restoration activities on marbled murrelet habitat?*
6. *What are the effects of restoration activities on northern spotted owl habitat?*
7. *What are the effects of restoration activities on coho salmon habitat?*
8. *How would restoration activities affect the presence and spread of noxious weeds?*
9. *What would be the economic effects of restoration activities?*
10. *What are the costs of restoration?*

# Issues considered, but not analyzed

- ***What are the effects of restoration activities on air quality?***

  Several of the action alternatives would include activities which could affect air quality, including smoke from prescribed burning and dust from road use and construction. Given the minor amount and diffuse nature of these activities that would occur, none of the alternatives would have a significant effect on air quality, and the effects have been already analyzed in the EIS for the Eugene District RMP (USDI Bureau of Land Management 1994, pp. 4-10 - 4-14).

- ***What are the effects of restoration activities on stream temperature?***

  The Siuslaw Watershed Analysis (1996) indicated that summer temperatures in the Siuslaw River itself are high, but that direct solar radiation is the factor with the greatest effect on water temperature (Siuslaw Watershed Analysis, pp. II-12, III-7).

All alternatives would maintain sufficient stream shading so as to avoid contributing to increased water temperature. Furthermore, the addition of large wood to streams in the action alternatives would provide stream shading, accumulate gravels, and create deeper pools, which would contribute to the cooling of stream temperatures. Therefore, all of the alternatives would either maintain or slightly cool stream temperatures in the planning area. The WQRP will address specific actions and monitoring features that pertain to maintenance of stream temperature.

- *What are the effects of restoration activities on dissolved oxygen in streams?*

The effects of restoration activities on levels of dissolved oxygen in streams was not analyzed, because analysis of this issue at the landscape scale is largely impractical. Furthermore, it is reasonably foreseeable that water temperature itself has more effect on dissolved oxygen levels in streams in the planning area than would inputs of organic material associated with restoration activities over a 10-year period. However, because dissolved oxygen levels are identified in the draft 303(d) listing for the Siuslaw River, and the action alternatives would include activities which could affect biological oxygen demand, a brief discussion of this issue is provided below.

Under all action alternatives, large quantities of fine organic material could be introduced into small streams, which could affect dissolved oxygen levels. Low dissolved oxygen levels in small streams could potentially adversely affect the survival and growth of salmonids and other aquatic-dependent species. However, the streams in which restoration actions would occur typically exhibit cool water temperatures, low biochemical oxygen demand (BOD), and rapid aeration rates. Forest streams, especially 1st and 2nd-order streams, are typically at or close to saturation of dissolved oxygen (DO).

A few studies have indicated areas of low DO in low gradient streams which were loaded with logging debris that impounded the streams. Low DO levels in forest streams are most commonly associated with heavy inputs of fine, fresh organic material; high water temperatures; low stream gradient; very slow moving water; low stream flow; or areas where oxygen reaeration is poor. Although input of large quantities of fine organic material has the potential to increase BOD during low stream flow and high water temperatures, most forest streams have enough turbulence to maintain a high amount of DO in the water column, even during low flows.

The WQRP will address specific actions and monitoring features that pertain to maintenance of dissolved oxygen levels.

- *What are the effects of restoration activities on peak flows in streams?*

The planning area is of low elevation, and the watershed lacks any substantial areas in the transient snow zone in which rain-on-snow events are more likely (USDI BLM 1996a, p. 1-9). Therefore, there would be no discernible difference in how the different thinning regimes in the alternatives would affect the peak flows in streams. The Cottage Grove/Big River Watershed Analysis, for a watershed east of the planning area, provides a discussion of the effect of vegetation management in the transient snow zone on peak flows (USDI BLM 1997, pp. 3-16 - 3-18; 4-2 - 4-3).

- *What are the effects of restoration activities on red tree vole habitat?*

Analysis of the specific effects on habitat for the red tree vole (which is a prey species for northern spotted owls) would be substantially similar to the broader analysis of the effects on northern spotted owl habitat, which is included in this EIS.

- ***What are the effects of contract logging instead of selling timber?***

**Some scoping comments urged BLM to contract directly the logging of stands to be thinned and sell the logged timber, rather than the more usual method of selling a timber sale at auction and having the purchaser arrange for the logging of the stand. This issue was not analyzed because the two methods do not differ in their environmental effects. Any specific methods or procedures that are identified for implementation of the selected alternative will be addressed in the eventual Record of Decision.**

# CHAPTER 2

# The Alternatives

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# Introduction

Council on Environmental Quality (CEQ) regulations direct that an EIS shall "... rigorously explore and objectively evaluate all reasonable alternatives ..." 40 CFR § 1502.14. CEQ guidance further explains:

> *"When there are potentially a very large number of alternatives, only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared in the EIS."* ("Forty Most Asked Questions ..." 46 Fed. Reg. 18027 (Mar. 23, 1981)).

For a multi-resource activity plan, such as is proposed here, there are potentially endless variations in design features or combinations of different plan components. The range of alternatives analyzed in this EIS is intended to span the full spectrum of alternatives that would respond to the purpose and need for the action. The alternatives analyzed were developed to represent overall management approaches, rather than exemplify gradations in design features.

Furthermore, the alternatives analyzed here do not provide all possible combinations of plan components. There are components of the alternatives that are somewhat separable: upland forest silviculture, in-stream restoration, and road decommissioning, for example. We constructed the alternatives with the intent of including components most consistent with the overall management approach of the alternative. It is possible that the decision-maker might select a new combination of components in an eventual Record of Decision. Such a selection might be possible without further analysis if the analysis of the different components is sufficiently separable that the overall impacts of a new combination of components would be apparent.

# Alternatives Analyzed in Detail

This EIS analyzes six alternatives in detail: the No Action alternative and five action alternatives. The following section provides a description of the overall management approach of each alternative and summarizes the actions (see Table 1). These summaries include the actions that we would implement during the 10-year span of this proposed plan, as well as reasonably foreseeable future actions under each management approach. Because terrestrial and aquatic restoration may take more than a century to achieve, it is important to analyze the long-term impacts of the alternatives, which requires some forecasting of future management actions beyond the 10-year span of this proposed plan. We make this forecasting only for the purpose of cumulative impact analysis, and we are not making any decision in principle to implement such future actions beyond the 10-year span of this proposed plan.

Appendix A provides a detailed description of the objectives, actions, guidelines, and mitigation measures for each action alternative for the 10-year span of the proposed plan.

## Mitigation Measures

Mitigation measures are taken to make the effects of an action less harsh or severe. The CEQ regulations state that mitigation includes avoiding impacts, minimizing impacts, reducing impacts, or compensating for impacts (40 CFR 1508.20). We have incorporated mitigation measures into the design of each alternative, as described in the guidelines and mitigation measures in Appendix A.

**Table 1**

**Summary of the major features of the alternatives**
**(treatments that would occur during the 10-year span of the proposed plan)**

| FEATURE | ALTERNATIVE | | |
|---|---|---|---|
| | A | B | C |
| | No action | Plantation and road management with no timber harvest | Continue current management approach |
| **very young stands (≤20 years old) 2,900 acres** | – no treatment | – thin 90% of acres<br>– low-moderate density | – thin 100% of acres<br>– moderate-high density<br>– even spacing |
| **young stands (21-50 years old) 8,700 acres** | – no treatment | – thin 75% of acres<br>– moderate-high density<br>– variable spacing<br>– no removals | – thin 5% of acres<br>– low-moderate density<br>– even spacing<br>– thinning >40 years old |
| **mid-seral stands (51-80 years old) 2,200 acres** | – no treatment | – no treatment | – thin 20% of acres<br>– low-moderate density<br>– even spacing |
| **riparian conifer stand treatment (<100' from streams)** | – no treatment | – same as uplands | – no thinning <50' from stream |
| **riparian hardwood stands 200 acres** | – no treatment | – no treatment | – convert 5% to conifers |
| **In-stream woody debris** | – none | – none | – 56 structures/mile on 3.8 stream miles, including cabling |
| **new road construction** | – none | – none | – as needed |
| **road decommissioning** | – none | – all roads where legally possible | – roads delivering sediment to streams<br>– roads in late-successional forest |

| ALTERNATIVE | | | |
|---|---|---|---|
| **D** | **E** | **F** | |
| **T&E species recovery** | **Reduce stand densities as quickly as possible** | **Multi-entry and multi-trajectory thinning** | **FEATURE** |
| – thin 90% of acres<br>– low-moderate density<br>– variable spacing | – thin 90% of acres<br>– very low density<br>– variable spacing | – thin 90% of acres<br>– moderate-high density<br>– even spacing | **very young stands (≤20 years old) 2,900 acres** |
| – thin 60% of acres<br>– wide range of densities<br>– variable spacing | – thin 75% of acres<br>– very low density<br>– variable spacing | – thin 48% of acres<br>– wide range of densities<br>– repeated thinnings | **young stands (21-50 years old) 8,700 acres** |
| – thin 20% of acres<br>– wide range of densities<br>– variable spacing<br>– no thinning >60 years old | – thin 25% of acres<br>– very low density<br>– variable spacing | – thin 24% of acres<br>– wide range of densities<br>– repeated thinnings | **mid-seral stands (51-80 years old) 2,200 acres** |
| – moderate density<br>– no removals | – same as uplands | – same as uplands | **riparian conifer stand treatment (<100' from streams)** |
| – convert 50% to conifers | – convert 75% to conifers | – convert 50% to conifers | **riparian hardwood stands 200 acres** |
| – 30 structures/mile on 3.8 stream miles, including cabling<br>– 160 pieces/mile on all 1st and 2nd order streams | – 160 pieces/mile on all streams<br>– no structures<br>– no cabling | – 56 structures/mile on 3.8 stream miles, including cabling | **in-stream woody debris** |
| – temporary spurs only | – as needed | – as needed | **new road construction** |
| – roads delivering sediment to streams<br>– roads in or adjacent to late-successional forest | – roads delivering sediment to streams<br>– roads in or adjacent to late-successional forest | – roads delivering sediment to streams<br>– roads in late-successional forest | **road decommissioning** |

## Features Common to All Alternatives

Under all alternatives, including the No Action alternative, we could continue to take management actions specifically required by the RMP or by law or policy. Such actions include, but are not limited to:

- wildfire suppression (see USDI BLM 1995, pp. 31, 105; USDA and USDI 1997, Appendix A, p. 1)

- salvage of dead trees following stand-replacing disturbance events exceeding 10 acres and posing a high risk of future large-scale disturbance (USDA and USDI 1994, pp. C-13 - C-16; USDI BLM 1995, p. 30; USDA and USDI 1997, p. 41).

- felling of hazard trees along roads and trails, and in campgrounds (USDI BLM 1995, p. 30, 31)

- maintenance of BLM-controlled roads

- construction of roads on BLM land by adjacent landowners, as authorized by existing road use agreements. Existing rights-of-way, contracted rights, easements, or use permits would be considered valid uses and would be designed to reduce adverse impacts on Late-Successional Reserves (USDA and USDI 1994, p. C-19; USDI BLM 1995, p. 32).

Additional management actions that are not directly related to the restoration purposes of this proposed plan would likely continue to occur within the LSR (e.g., research, recreation use, and land tenure actions). These actions are described by resource program in the RMP.

# ALTERNATIVE A

## NO ACTION

*No management actions, except those specifically required*

This alternative would take no management actions to protect and enhance late-successional and old-growth forest ecosystems; to foster the development of late-successional forest structure and composition in plantations and young forests; or to reconnect streams and reconnect stream channels to their riparian zones and upslope areas. Only those management actions specifically required by the RMP or by law or policy would occur, as discussed above under "Features Common to All Alternatives."

# ALTERNATIVE B

## PLANTATION AND ROAD MANAGEMENT WITH NO TIMBER HARVEST

***Restore plantations and roads and let nature do the rest***

This alternative is designed to accomplish restoration without timber removal. It would thin Douglas-fir plantations, but not unmanaged stands. Because no cut trees would be removed, the risk of fire and insect infestation would constrain thinning prescriptions, except in very young stands.

Very young stands (≤20 years old) would be thinned to variable spacing at low to moderate densities.

Young stands (21-50 years old) would be thinned to variable spacing at moderate to high densities. Both very young and young stands would undergo subsequent coarse woody debris and snag creation treatments every 10-20 years. Shade-tolerant conifers would be planted at the time of subsequent coarse woody debris and snag creation.

Mid-seral stands (51-80 years old) would not be thinned.

Riparian areas (<100' from streams) which are conifer-dominated would be treated the same as upland stands. Riparian areas which are hardwood-dominated would not be treated.

No trees would be specifically felled or pulled into streams, and no in-stream structures would be constructed. All high-risk and fish-barrier culverts would be removed or replaced.

All roads would be decommissioned where legally possible. No new roads would be constructed.

# ALTERNATIVE C

## CONTINUE CURRENT MANAGEMENT APPROACH

***Manage young stands using current silvicultural techniques and continue riparian restoration at the current pace of work***

This alternative is designed to accomplish restoration using current silvicultural techniques and stream restoration strategies. Thinning would be concentrated in stands 41-80 years old and would have targets for moderate stand densities and relatively even tree spacing. Most cut trees would be removed from thinned stands to minimize the risk of fire and insect infestation.

Very young stands (≤20 years old) would be thinned to even spacing at moderate to high densities without any timber removal. A second thinning of the overstory would occur approximately 30 years later, which would require timber removal.

Young and mid-seral stands (40-80 years old) would be thinned from below to relatively even spacing at a range of densities, with some timber removal. Shade-tolerant conifers would be planted at the time of thinning. Coarse woody debris and snags would be created at the approximate time of thinning. There would be few if any subsequent treatments of thinned stands.

Riparian areas (<100' from streams) which are conifer-dominated would be treated the same as upland stands, but would not be thinned within 50' of streams. A small portion of the riparian areas which are hardwood-dominated would be thinned, and conifers would be planted at the time of thinning.

In-stream structures would be constructed, and some structures would be cabled for stability in larger streams. In-stream structures would include weirs, cascades, jetties, and/or ramp logs. These types of structures are described in detail in the Upper Siuslaw Aquatic Habitat Restoration Plan (EA OR090-EA-98-17), which is incorporated here by reference. Trees would be felled into smaller streams adjacent to thinning projects. All high-risk and fish-barrier culverts would be removed or replaced.

Non-shared roads capable of delivering sediment to streams, damaged roads not needed for future access, and roads that dead-end in late-successional stands would be decommissioned. New roads would be constructed as needed to access areas selected for thinning.

# ALTERNATIVE D

## T&E Species Recovery

***Maximize the development of habitat for northern spotted owls, marbled murrelets, and coho salmon where possible with minimal impacts to existing habitat***

This alternative is designed to take advantage of restoration opportunities that would have the least short-term adverse effects with the most long-term benefits to habitat for northern spotted owls, marbled murrelets, and coho salmon. Thinning would be concentrated in younger stands and would have targets for a wide range of stand densities and high variability of tree spacing. Some cut trees would be removed from thinned stands to reduce the risk of fire and insect infestation. All stand thinning requiring timber removal would be completed within the next 10 years, and subsequent treatments, such as tree planting and snag and coarse woody debris creation, would not require road access.

Very young stands (≤20 years old) would be thinned to variable spacing at low densities without any timber removal.

Young and mid-seral stands (21-60 years old) would be thinned to variable spacing at a wide range of densities with some timber removal. Shade-tolerant conifers would be planted at the time of thinning. Both very young and young stands would undergo subsequent coarse woody debris and snag creation every 10-20 years. Stands older than 60 years old would not be thinned.

Riparian areas (<100' from streams) which are conifer-dominated would be thinned from below without any timber removal. Thinned stands would undergo subsequent coarse woody debris and snag creation every 10-20 years. Shade-tolerant conifers would be planted at the time of subsequent coarse woody debris and snag creation. Approximately half of the riparian areas which are hardwood-dominated would be thinned, and conifers would be planted at the time of thinning.

In-stream structures would be constructed, and some structures would be cabled for stability in larger streams, similar to Alternative C. Trees would be felled into all streams adjacent to stands ≤80 years old. All high-risk and fish-barrier culverts would be removed or replaced.

Non-shared roads capable of delivering sediment to streams, damaged roads, and roads within or adjacent to late-successional forest, would be decommissioned. New road construction would be limited to temporary spur roads each less than 200 feet.

# ALTERNATIVE E

## REDUCE STAND DENSITIES AS QUICKLY AS POSSIBLE

***Achieve tree densities typical of local late-successional forests as soon as possible***

This alternative is designed to reduce stand densities as quickly as possible. Thinning would occur in all age classes ≤80 years old and would have targets for very low stand densities and high variability of tree spacing. Some cut trees would be removed from thinned stands to reduce the risk of fire and insect infestation. All stand thinning requiring timber removal would be completed within the next 10 years, and subsequent treatments, such as tree planting and snag and coarse woody debris creation, would not require road access.

Very young stands (≤20 years old) would be thinned to variable spacing at very low densities without any timber removal. Very young stands would require a subsequent thinning of the understory, approximately 20-40 years later, which would likely not require timber removal. Shade-tolerant conifers would be planted at the time of the second thinning. Very young stands would undergo subsequent coarse woody debris and snag creation, approximately 60 years after thinning.

Young and mid-seral stands (21-80 years old) would be thinned to variable spacing at very low densities with some timber removal. Shade-tolerant conifers would be planted at the time of thinning. Young stands might require a subsequent thinning of the understory, approximately 20 years later, which would not require timber removal. Young and mid-seral stands would undergo a single subsequent treatment for coarse woody debris and snag creation, approximately 20-50 years after thinning.

Riparian areas (<100' from streams) which are conifer-dominated would be treated the same as upland stands. Most riparian areas which are hardwood-dominated would be thinned, and conifers would be planted at the time of thinning.

Trees would be felled or pulled into all streams adjacent to stands ≤80 years old. No structures would be constructed, and woody debris would not be cabled for stability. All high-risk and fish-barrier culverts would be removed or replaced.

Non-shared roads capable of delivering sediment to streams, damaged roads, and roads within or adjacent to late-successional forest, would be decommissioned. New roads would be constructed as needed to access areas selected for thinning.

# ALTERNATIVE F

## Multi-entry and Multi-trajectory Thinning

***Maintain stand vigor by increasing growing space, developing wind firmness, and maintaining crown development, while maintaining canopy closure***

This alternative is designed to accomplish restoration using multiple thinning of stands to establish five different stand trajectories. Thinning would occur in all age classes 80 years old. Thinning entries would be designed to maintain moderate to high canopy closure, and would have targets for a range of stand densities. Most cut trees would be removed from thinned stands to minimize the risk of fire and insect infestation.

Very young stands (≤20 years old) would be thinned to even spacing at moderate to high densities without timber removal. The overstory would be subsequently thinned two to three times, approximately 20 years apart. Subsequent thinning beyond the 10-year span of this plan might include patch cuts. All subsequent thinnings would require timber removal. Shade-tolerant conifers would be planted at the time of the first subsequent thinning. Coarse woody debris and snags would be created at the approximate time of each subsequent thinning.

Young and mid-seral stands (21-80 years old) would be thinned from below at a wide range of densities, with timber removal. Shade-tolerant conifers would be planted at the time of thinning. The overstory would be subsequently thinned one to two times, approximately 20 years apart. Subsequent thinning beyond the 10-year span of this plan might include patch cuts. All subsequent thinnings would require timber removal. Coarse woody debris and snags would be created at the approximate time of each thinning.

Riparian areas (<100' from streams) which are conifer-dominated would be treated the same as upland stands. Approximately half of riparian areas which are hardwood-dominated would be thinned, and conifers would be planted at the time of thinning.

In-stream structures would be constructed on larger streams, and some would be cabled for stability, similar to Alternative C. All high-risk and fish-barrier culverts would be removed or replaced.

Non-shared roads capable of delivering sediment to streams, damaged roads not needed for future access, and roads that dead-end in late-successional stands would be decommissioned. New roads would be constructed as needed to access areas selected for thinning.

# Identification of the Preferred Alternative

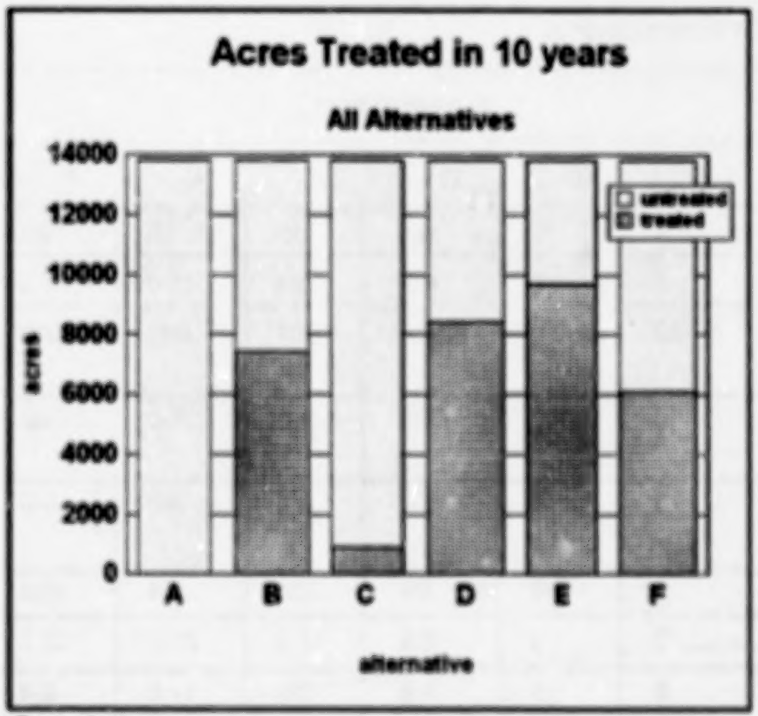
Several of the alternatives analyzed in detail would effectively fulfill our "... statutory mission and responsibilities, giving consideration to economic, environmental, technical, and other factors" and thus be appropriate as the preferred alternative ("Forty Most Asked Questions ..." 46 Fed. Reg. 18027 (Mar. 23, 1981)). Nevertheless, BLM and the FWS identify Alternative D as the preferred alternative, because it would:

- effectively foster the development of late-successional forest structure;
- thin stands to a wide range of stand densities, which would maintain future management options;
- maintain the current amount of dispersal habitat for northern spotted owls;
- decommission the most damaging roads;
- moderate the risk of wildfire over time; and
- generate revenue greater than the costs, indicating the feasibility of implementing the overall restoration program.

The BLM and FWS preference among the alternatives may change in the Final EIS based on public comments, other agency comments, and any additional analysis that may be needed for the Final EIS.

# Summary of Environmental Impacts

This section summarizes the analytical results that serve to highlight the differences among the alternatives (see Table 2). Chapter 4 describes in detail the environmental consequences of the alternatives and presents further comparison of the effects of the alternatives at the end of that chapter.



Graph 1

The proportion of stands currently ≤80 years old that would be thinned during the 10-year analysis period varies widely among the action alternatives. No more than 70% of these stands would be thinned under any alternative (see Graph 1).

**Alternative A (No Action)** would leave the existing road system intact and would generate no economic activity. Stands currently 40 years old would quickly become spotted owl dispersal habitat, but would not attain late-successional structure within the 100-year analysis period (see Table 2). Alternative A would not create any stable in-stream structure on larger ($3^{rd}$-$5^{th}$-order) streams.

**Alternative B** would decommission the greatest length of roads and build no new roads. It would not slow the development of spotted owl dispersal habitat. It would have limited effectiveness in speeding the attainment of late-successional forest structure. Alternative B would not create any stable in-stream structure on larger streams. It would have no revenue and moderate costs.

**Alternative C** would decommission a small length of roads and would build a small amount of new roads. It would not slow the development of spotted owl dispersal habitat. It would not effectively speed the attainment of late-successional structure. Alternative C would create stable in-stream structure on larger streams only where accessible to heavy machinery. The revenues would be slightly lower than the costs.

**Alternative D** would decommission a moderate length of roads and would build a small amount of new roads. It would slow the development of spotted owl dispersal habitat (although it would always maintain the current amount). It would effectively speed the attainment of late-successional structure. Alternative D would create stable in-stream structure on more streams than any other alternative. The moderate revenues would exceed the costs.

**Alternative E** would decommission a moderate length of roads, but would build the greatest length of roads. It would slow the development of spotted owl dispersal habitat (and temporarily reduce it below the current amount). It would be the most effective at speeding the attainment of late-successional structure. Alternative E would create stable in-stream structure on a moderate length of larger streams. It would generate the most economic activity and would have the highest revenues, which would substantially exceed the costs.

**Alternative F** would decommission a small length of roads build a small amount of new roads. It would not slow the development of spotted owl dispersal habitat. It would have limited effectiveness in speeding the attainment of late-successional forest structure. Alternative F would create stable in-stream structure on larger streams only where accessible to heavy machinery. It would generate almost as much economic activity as Alternative E, and the high revenues would substantially exceed the costs.

**Table 2. Summary of the effects of the alternatives**

| FEATURE | ALTERNATIVE | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | F |
| Road decommissioned (miles) | 0 | 79 | 24 | 45 | 45 | 24 |
| New road built (miles) | 0 | 0 | 6.9 | 3.6 | 15.0 | 11.5 |
| Stands that become owl dispersal habitat by 2022 (acres) | 8,100 | 8,100 | 8,100 | 5,500 | 600 | 8,000 |
| Stands that develop late-successional structure by 2097 (acres) | 0 | 2,300 | 100 | 6,000 | 8,800 | 1,000 |
| Stable instream structures created on 3rd to 5th order streams (miles) | 0 | 0 | 3.8 | 8.2 | 5.8 | 3.8 |
| Contracts (months of work) | 0 | 298 | 69 | 236 | 384 | 383 |
| Total revenue (millions of dollars) | 0 | 0 | 2.8 | 11.6 | 20.2 | 12.7 |
| Total costs (millions of dollars) | 0 | 5.6 | 3.5 | 8.8 | 14.5 | 6.9 |

# Alternatives Considered, but Eliminated from Detailed Analysis

An EIS for a multi-resource activity plan, such as that proposed here, need not analyze alternatives that are inconsistent with the existing management plans to which it is tiered (in this case, the Northwest Forest Plan and the RMP). In general, an EIS also need not analyze alternatives that are infeasible, ineffective (i.e., would not respond to the purpose and need for the action), or substantially similar to alternatives that are analyzed. Finally, an EIS need not analyze alternatives whose effect cannot be reasonably ascertained.

In developing this draft EIS, the following alternatives were considered as a result of internal or external scoping, but were eliminated from detailed analysis, as explained below.

### *1. No Action, with no wildfire suppression and no salvage*

This alternative would conduct no management actions under any circumstances. Such an alternative would not be consistent with the Northwest Forest Plan and the RMP. The Northwest Forest Plan established that the goal of wildfire suppression in Late-Successional Reserves is to limit the size of all fires and directed the preparation of a fire management plan to guide wildfire suppression (USDA and USDI April 1994, p. C-18). The fire management plan for LSR 267 prepared as part of the LSR Assessment states that all wildfires will be suppressed (USDA and USDI 1997, Appendix A, p.1). To preclude wildfire suppression under any circumstances would be beyond the scope of this action and would not be consistent with the Northwest Forest Plan and the RMP.

The Northwest Forest Plan and the RMP provide detailed standards and guidelines for conducting salvage within LSRs, designed to prevent negative effects on late-successional habitat and facilitate habitat recovery following disturbance (USDA and USDI April 1994, pp. C-13 - C-16; USDI BLM 1995, p. 30). The proposed restoration plan does not specifically address salvage following future disturbances. The need for any such salvage would be evaluated following a specific disturbance, based on the guidance in the Northwest Forest Plan and the RMP. To preclude salvage under any circumstances would be beyond the scope of this action and would not be consistent with the Northwest Forest Plan and the RMP.

### *2. Citizen's Alternative to the Northwest Forest Plan*

This "alternative" to the Northwest Forest Plan was proposed by several environmental groups in March 2000 (http://www.onrc.org/programs/wforest/citizens.htm). None of the groups affiliated with this "Citizen's Alternative" specifically suggested it in the scoping for this EIS. Although the "Citizen's Alternative" does include a section related to restoration in young plantations, the "Citizen's Alternative" as presented on the website does not provide sufficient detail for analysis in this EIS. To the extent that the features of the "Citizen's Alternative" are evident, it appears that this alternative would be substantially similar to Alternative B. Although the "Citizen's Alternative" does not explicitly prohibit timber harvest (which Alternative B does), it provides such restrictive conditions for timber removal that they would likely constitute a de facto prohibition on timber removal in most stands, at least during the 10-year span of the proposed plan.

### *3. Extensive use of fire to thin stands*

This alternative would use prescribed fire, rather than tree-cutting, to reduce the density of young stands. This alternative was not suggested in the scoping for this EIS, but has been suggested in comments on individual projects that preceded development of this EIS. This alternative would be impractical and ineffective at achieving the purpose of the action. In young, high-density plantations, such as predominate in the planning area, a fire hot enough to kill individual trees would likely become a crown fire and destroy the entire stand. Even in the unlikely circumstance that a prescribed fire could be used to reduce stand density without destroying the entire stand, fire would kill any understory shade-tolerant conifers within the stand. Therefore, an alternative that uses prescribed fire instead of tree-cutting would be ineffective at fostering the development of late-successional forest structure and composition in plantations and young forests. Additionally, use of prescribed fire in young plantations would entail a high risk of fire spreading to existing late-successional forest. Therefore, an alternative that uses prescribed fire instead of tree-cutting would be ineffective at protecting late-successional and old-growth forest ecosystems.

### *4. Heavy thinning without timber removal*

This alternative would be somewhat similar to Alternative B, but would not include mitigations to reduce risk of wildfire and Douglas-fir bark beetle infestation. This alternative would also be somewhat similar to Alternative E, but without timber removal. Leaving such great quantities of cut trees on the ground would pose an unacceptable risk of wildfire and Douglas-fir bark beetle infestation and thus would be ineffective at protecting late-successional and old-growth forest ecosystems, and fostering the development of late-successional structural characteristics in young stands. For example, thinning 40-year-old stands with prescriptions similar to Alternative E would leave approximately 90 trees per acre >12" diameter at breast height (dbh) on the ground, which could result in subsequent mortality of the rest of the stand from bark beetle infestations and would pose a high risk to nearby late-successional stands. Without timber removal, such an alternative would lack the opportunity for adaptive management, such as adjusting the amount of wood left on the ground based on bark beetle population levels. Additionally, applying such prescriptions across the landscape without timber removal would result in half of the young stands in the very high risk fuel models, and more than half of the young stands in a high-risk fuel models for more than 40 years. This is substantially greater than the risk in the alternatives analyzed in detail.

### *5. Thinning stands >80 years old*

An alternative that would include thinning in stands >80 years old would not be consistent with the Northwest Forest Plan and the RMP. The Northwest Forest Plan states that in LSRs, "There is no harvest allowed in stands over 80 years old ... Thinning (precommercial and commercial) may occur in stands up to 80 years old ..." (USDA and USDI April 1994, p. C-12; USDI BLM 1995, p. 30). Regardless of this prohibition, mature stands (81-200 years old) make up a very small portion of the planning area (approximately 9%), and the LSR Assessment and Siuslaw Watershed Analysis did not identify any need for treatment in these stands.

### *6. Clearcut high density stands and replant at lower densities*

This alternative would be based on the assumption that high-density, even-aged stands cannot develop late-successional forest structure, even with thinning, and therefore regenerating the stands would be the only option to attain late-successional forest structure. This assumption is not consistent with the analysis for the Northwest Forest Plan (USDA and USDI February 1994, pp. 3&4-42 - 3&4-46), and an alternative that would cut all of the trees in stands would not be consistent with the Northwest Forest Plan and the RMP. The Northwest Forest Plan provided for thinning and other silvicultural treatments beneficial to the creation and maintenance of late-successional forest conditions (USDA and USDI April 1994, pp. 8; C-12; USDI BLM 1995, p.30), but did not provide for the regeneration of existing stands. The LSR Assessment and Siuslaw Watershed Analysis did not identify any need for such drastic treatment of stands, and in fact highlighted the potential beneficial effect of thinning on existing, high-density stands (USDA and USDI 1997, pp. 34-41; USDI BLM 1996a, pp. V-1 - V-3).

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# CHAPTER 3

# Affected Environment

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# Introduction

Several documents have analyzed the affected environment of the planning area. The Northwest Forest Plan FSEIS analyzed the regional ecosystem within the range of the northern spotted owl (USDA and USDI February 1994). The Northwest Forest Plan FSEIS relied in part on the report titled Forest Ecosystem Management: An Ecological, Economic, and Social Assessment (the FEMAT Report, USDA Forest Service et al. 1993), which was included as an appendix to the Northwest Forest Plan FSEIS. The FEMAT Report and the Northwest Forest Plan FSEIS describe the terrestrial and aquatic ecosystem conditions across the region, with particular emphasis on the amount and condition of existing late-successional forest; the ecological role of late-successional forests; and watershed conditions and processes. Those portions of Chapters 3&4 of the Northwest Forest Plan FSEIS (including the FEMAT Report attached in Appendix A) that describe terrestrial and aquatic ecosystem conditions and processes are incorporated here by reference.

The EIS for the Eugene District RMP (RMP EIS) further describes terrestrial and aquatic ecosystem conditions and processes for ecosystems typical of the Eugene District (USDI BLM 1994, pp. 3-14 - 3-62) and describes in detail special areas and special status species within the Eugene District (USDI BLM 1994, pp. 3-62 - 3-98). The RMP EIS also describes resource programs and facilities within the Eugene District (USDI BLM 1994, pp. 3-99 - 3-121) and the existing economic and social conditions in the general area (USDI BLM 1994, pp. 3-121 - 3-131). Those portions of Chapters 3 of the RMP EIS that describe the affected environment are incorporated here by reference.

The LSR Assessment details terrestrial ecosystem conditions and processes within LSR 267 and LSR 268, with particular emphasis on forest stand development and existing late-successional forest conditions (USDA and USDI 1997, pp. 8-20, 47-66). The LSR Assessment stresses the importance of the planning area for dispersal of species associated with late-successional forests (USDA and USDI 1997, p. 30). The LSR Assessment also includes a Fire Management Plan for the planning area (USDA and USDI 1997, Appendix A). The Siuslaw Watershed Analysis details terrestrial and aquatic ecosystem conditions and processes within the Siuslaw River fifth-field watershed (USDI BLM 1996a). The Siuslaw Watershed Analysis includes a stream-by-stream analysis of current fish habitat conditions (USDI BLM 1996a, pp. II-38 - II-47). The LSR Assessment and Siuslaw Watershed Analysis are incorporated here by reference.

Since the LSR Assessment and Siuslaw Watershed Analysis were completed, BLM has conducted some additional surveys, analysis, and management actions in the planning area. This new information, which is summarized below, is not significant relative to the analytical conclusions or recommendations in the LSR Assessment or Siuslaw Watershed Analysis and is not significant relative to the decisions in the RMP. Therefore, there is no need to conduct an additional LSR Assessment or an additional iteration of the watershed analysis, and there is no need to consider an RMP amendment for Late-Successional Reserve or aquatic management at this time.

# Roads

BLM maintains approximately 169 miles of road on BLM-managed land in the planning area, for a total road density of 4.4 miles of road for every square mile of land. Approximately 75 miles of these roads provide "legal public access", according to the BLM Facility Inventory Maintenance Management System. "Legal public access" is defined as either (a) roads for which BLM has acquired a public easement across private land; or (b) roads that begin on BLM-managed land that is legally accessible from state or county roads.

**Figure 2.** *The road inventory found 65 miles of road capable of delivering sediment to streams.*

Over the past decade, large timber companies have increasingly closed their land to public access, partly in response to littering, vandalism, and inappropriate vehicle use. This trend is likely to continue and could increase the importance of the existing public access within the planning area.

In 2002, BLM completed a road inventory of the planning area. Approximately 2.5 miles of road has been decommissioned in the planning area since the analysis conducted for the Siuslaw Watershed Analysis. The road inventory lists approximately 12 miles of road that are "passively" decommissioning (i.e., the road has become impassable over time because of lack of maintenance and traffic).

The Siuslaw Watershed Analysis estimated that road-related sedimentation represents only an approximately 5% increase over natural background levels (USDI BLM 1996a, pp. II-7 - II-8). The 2002 road inventory identifies approximately 65 miles of road on BLM-managed lands in the planning area that are capable of delivering fine sediments to streams (see Figure 2). Furthermore, approximately 10% of these road segments are not experiencing any traffic and are "passively" decommissioning, but still erode sediment from the road prism.

The road inventory also identifies approximately 73 culverts on BLM-controlled road segments that are currently at high risk for failure because of undersized culverts and plugged culverts. The ratings used to determine high risk included the risk to fish streams and high numbers of at-risk culverts along a road segment.

## Fire and Fuels

The majority of stands 80 years old in the planning area are currently in an understory short shrub fuel model (63%); smaller portions are in a tall shrub model (21%) and a dense timber stand model (16%). See Chapter 4, Issue 3, for a description of the fuel models.

Fires within the planning area are rare: the fire occurrence from 1985-2001 was only 0.07 fires occurring per 1,000 acres per year, resulting in a total of 35 acres burned. Escaped slash burns have been the most common source of ignition. However, large fires are possible in the planning area: the Oxbow fire in 1966 burned approximately 42,000 acres (USDI BLM 1996a, p. II-33; USDA and USDI 1997, p. A-1). The Fire Management Plan of the LSR Assessment provides additional information on fire management (USDA and USDI 1997, Appendix A).

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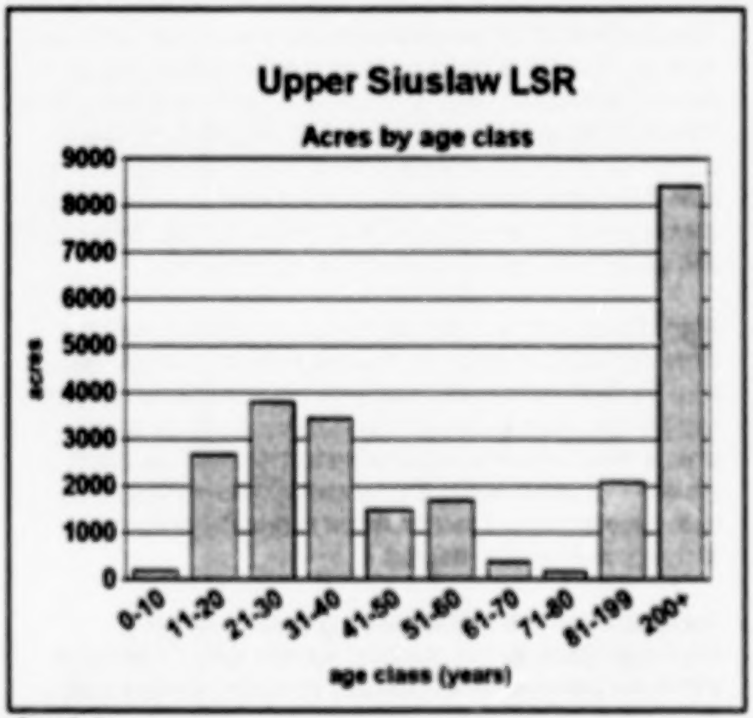
# Forest Management

Prior to the establishment of LSRs by the Northwest Forest Plan, the intended silvicultural pathway for the stands in the planning area was a commercial thinning at age 35-45 years, and a final (clearcut) harvest at age 60-80 years. This silvicultural regimen was designed to produce high-density, single-aged stands of Douglas-fir to maximize the commercial value of timber produced. This effort was largely successful, and the resulting plantations are dense, uniform stands that are structurally quite different from natural stands in the planning area.

More than half of forest stands in the planning area are ≤80 years old (see Graph 2 and Map 8). Almost all stands in the planning area <60 years of age have been regenerated following timber harvest, and most have been either seeded or planted, and then pre-commercially thinned. Timber harvest in the planning area began as early as the 1940s. The predominant silvicultural system used at the time was a "seed tree" system, in which a few scattered trees were left to naturally reseed the harvest area. In the planning area, seed trees were usually cut once the new stand was established. From the 1960s to the 1990s, timber harvest largely shifted to a clearcut system, in which all trees within the harvest area were cut at once. Site preparation typically included burning of slash to control brush and create planting spots for new trees. The harvest area was then artificially seeded or planted with tree seedlings, which were almost always exclusively Douglas-fir. Trees were usually planted at very high densities (440-680 trees per acre (TPA)).

Most young plantations in the planning area were pre-commercially thinned (PCT) at age 10-20 years old to standardize the tree stocking levels and remove less desirable tree species. Most plantations were thinned to a 12' by 12' spacing (300 TPA) of Douglas-fir, generally cutting all competing species. Since 1990, PCT within the planning area has shifted to wider spacing, usually 17' by 17' (150 TPA), leaving many hardwoods and conifers other than Douglas-fir.



Graph 2

BLM has sold two timber sales in the planning area since 1994: the Smith Creek thinning and the Fawn Creek Forest Management Project. The Smith Creek thinning, completed in 2000, thinned 14 acres of 26-year-old trees in a progeny test site located in Section 13, Township 20 South, Range 6 West. Management of the progeny test sites is part of continuing long-term forest genetics research, described in the Forest Genetics appendix to the RMP (USDI BLM 1995, pp. 261-263). Additional information can be found in Environmental Assessment (EA) OR090-98-21. The Fawn Creek Forest Management Project, located in Section 17, Township 20 South, Range 5 West, includes approximately 150 acres of density management thinning. BLM sold the timber sale portion of this project in 2001, but the stand has not yet been logged. Additional information can be found in EA OR090-01-21 (http://www.edo.blm.gov/nepa/eas/fawncreekea.pdf).

Between 1994 and 2000, BLM pre-commercially thinned additional young stands within the planning area. BLM pre-commercially thinned a total of 2,778 acres at the following spacing:

| | | |
|---|---|---|
| 540 acres | 13' x 13' | (260 TPA) |
| 403 acres | 14' x 14' | (220 TPA) |
| 154 acres | 15' x 15' | (190 TPA) |
| 1,390 acres | 17' x 17' | (150 TPA) |
| 291 acres | 20' x 20' | (110 TPA) |

In 1998, BLM created snags by both topping and girdling in a stand of 130 acres in Section 11, Township 20 South, Range 7 West. Four snags per acre were created around a co-dominant tree, which was thus released from competition.

In 1999 and 2000, BLM released individual trees in young plantations from competition by cutting all of the trees 30'-40' from a selected tree. Total treatments in young stands covered 770 acres in Sections 1, 11, 12, 13, and 14, Township 20 South, Range 7 West, and Section 35, Township 19 South, Range 7 West. Additional information can be found in EA No. OR090-98-31.

In Fall 2001 and Spring 2002, BLM thinned three one-acre plots to demonstrate probabilistic ("Monte Carlo") selection methods in a 28-year-old plantation in Section 31, Township 20 South, Range 5 West. Additional information can be found in the Categorical Exclusion review (CE) OR090-02-16, which is available online at http://www.edo.blm.gov/nepa/ces/montecarlo2CE.pdf.

# Northern Spotted Owl and Marbled Murrelet

In 1992, the FWS designated lands considered to be critical spotted owl habitat; these lands were encompassed in a series of critical habitat units (CHUs) (USDI Fish and Wildlife Service 1992a) (see Figure 3). Critical habitat, as defined by the FWS, includes roosting, nesting and foraging habitat (also called "suitable" habitat) for resident owls, and dispersal habitat for non-resident owls seeking an unoccupied territory. The entire planning area is within critical habitat for the northern spotted owl, and contains portions of two Critical Habitat Units: approximately one-third of CHU OR-53 and a very small amount (3%) of CHU OR-52 (see Map 9). The LSR Assessment provides additional information on habitat conditions and the location of the Critical Habitat Units (USDA and USDI 1997, pp. 22-23; Map 14; Appendix H).

**Figure 3.** *The LSR Assessment highlights the importance of the planning area for dispersal of late-successional forest species, including the northern spotted owl.*

Approximately 43% of the planning area (10,600 acres) is currently suitable habitat for the northern spotted owl (see Map 9). Only stands >80 years old are considered suitable habitat here. (On a stand-specific basis, some younger stands are considered suitable habitat for the purpose of project-level consultation if they contain sufficient late-successional forest characteristics to provide nesting, foraging, and roosting habitat.)

Approximately 60% of the planning area is currently dispersal habitat for the northern spotted owl. Of all lands within the planning area boundary (including private lands), approximately 40% of the total acreage is currently dispersal habitat.

Fourteen historical northern spotted owl sites have been located in the planning area since 1980. Since 1997, spotted owls have been found to reside in nine of these sites. The barred owl population has increased in the same time period, and barred owls now inhabit at least four of these sites. Habitat fragmentation is high due to past harvests on federal land and ongoing timber harvest on private lands. Only one spotted owl site has greater than 40% suitable habitat within its home range (the U.S. Fish and Wildlife Service considers owl sites to be at risk when they contain less than 40% suitable habitat within a home range delineated by a 1.5 mile radius).

The planning area is approximately 34-45 miles from the Pacific coast, which is near the 50-mile limit of expected marbled murrelet distribution in Oregon (USDA Forest Service et al. 1993, pp. IV-15 - IV-17). BLM has conducted marbled murrelet surveys since 1997 in stands proposed for thinning treatments. Marbled murrelets have been observed at three locations in the planning area: over a stand in Section 7, Township 20 South, Range 5 West, in Section 17, Township 20 South, Range 7 West, and under the canopy in a stand in Section 1, Township 20 South, Range 7 West. The last observation was an incidental sighting (i.e., not part of a survey effort), but meets the definition of an occupied site ("birds flying below, through, into, or out of the forest canopy within or adjacent to a site of potential habitat") (Evans Mack et al., 2002). Further surveys in all of these areas resulted in no additional observations.

## Coho Salmon and Aquatic Restoration

Coho salmon in the planning area appear to be maintaining their populations, but we cannot make any strong conclusions, because there have been few population and spawning surveys. In the adjacent Wolf Creek watershed, juvenile smolt trapping since 1995 has shown a steady increase in coho salmon, chinook salmon, and cutthroat trout populations.

The hydrology and aquatic and riparian habitat conditions are described in detail in the Watershed Analysis and the Upper Siuslaw Aquatic Habitat Restoration Plan (EA OR090-98-17), which is incorporated here by reference. The geology of the planning area is dominated by sedimentary oceanic deposits of siltstone and sandstone which have little capability to store or transport water. Because of the limited water storage capacity, stream flows are closely tied to precipitation patterns. Without adequate in-stream structure, stream channels have downcut through valley floor deposits. The Siuslaw River has downcut to bedrock along many reaches, causing an increase in channelization and secondary confinement of the flow, increasing velocities during peak flows and reducing habitat diversity. The majority of current riparian forests in the planning area are ≤80 years old, and riparian forests generally mirror the age-class distribution of the uplands.

The Watershed Analysis found that the salmon spawning and rearing habitat is limited in the planning area. Spawning gravels are usually located at the mouths of tributaries. The best remaining coho salmon habitat is mostly in the western portion of the planning area, in Haight, Bear, and Oxbow Creeks (see Map 10)

The Siuslaw Watershed Analysis details the condition of the Siuslaw River and its tributaries in the planning area. Both the Siuslaw River and many of its tributaries lack large woody debris to form adequate structures for fish cover, rearing, and spawning habitat. The watershed analysis recommends habitat creation through the placement of in-stream structure, and notes that the removal of barrier culverts could provide opportunity for aquatic species to reach otherwise suitable habitat. As noted above, the watershed analysis estimated that road-related sedimentation represents only an approximately 5% increase over natural background levels and concluded that road sediment delivery can be considered to be low and have no significant impact to the Siuslaw stream channel system (USDI BLM 1996a, pp. II-1 - II-6).

Aquatic enhancement efforts in support of the watershed analysis recommendations are ongoing. In 1998 and 1999, BLM placed hundreds of tons of boulders in a control location within the Siuslaw River channel to simulate six "cascades." The objectives of this type of structural installation included building up the confined, bedrock-dominated river channel and creating the potential for groundwater recharging (replenishing groundwater reservoirs), connecting the river and the adjacent flood plain, and increasing the structural complexity of the Siuslaw River and tributaries. Additional objectives included creating deep pools for fish cover, improving the availability of spawning, rearing and refuge habitat, and increasing the water-retention capacity in the upper basin during the low-flow summer months.

In 2000 and 2001, BLM focused aquatic restoration efforts on removing migration barriers to make additional habitat available to aquatic species in the following Siuslaw River tributaries: Oxbow Creek and tributaries; Frying Pan Creek and a tributary; Bear Creek; Haight Creek; Dogwood Creek; and Buck Creek. Six barrier culverts were removed and replaced with passage-friendly culverts, one barrier culvert was completely removed, and a stream enhancement project in Frying Pan Creek placed logs and boulders as key structural habitat features. These projects opened approximately 8.5 miles of usable stream habitat to aquatic species. Surveys in spring 2002 found that all of the barrier replacement culvert projects are allowing passage of either adult or juvenile coho salmon. The surveys did not find coho juveniles at the culvert removal site, but did observe juvenile and adult cutthroat in the general project location and in upstream habitats.

Five major tributaries of the Siuslaw River within the planning area currently have adequate woody debris to provide stable in-stream structures on 3rd-5th-order streams: Oxbow Creek, Doe Hollow, Dogwood Creek, Russel Creek, and Fawn Creek (see Map 10). Based on stream habitat surveys, BLM fish biologists have determined that 25 of the 45 miles of 3rd-5th-order streams in the planning area are a high priority for aquatic restoration efforts. Of these priority streams, approximately 12 miles currently have adequate woody debris. Of the remaining 13 miles that lack sufficient woody debris, only 3.8 miles are accessible by heavy equipment to perform in-stream restoration work (see Map 10).

The road inventory conducted in 2002 identifies culverts on both BLM and non-BLM-controlled roads within the planning area that affect the migration patterns of anadromous fish and resident fish, and aquatic organisms that historically utilized upstream habitat managed by BLM. The road inventory recommends either removal or replacement of 10 of 16 culverts on BLM-controlled roads. These barrier culverts on BLM-controlled roads impact 7.0 miles of usable coho habitat and 3.1 miles of steelhead and cutthroat habitat. The road inventory found seven culverts owned by Lane County and two privately-owned culverts that are potential barriers to aquatic species movement. Six of the seven county-owned culverts are near the confluences of major tributaries to the Siuslaw River and impact 15.0 miles of coho habitat. The two privately-owned culverts are partial barriers and impact 2.0 miles of coho habitat and 0.4 miles of steelhead and cutthroat habitat.

# Noxious Weeds

A District-wide inventory of noxious weed infestations conducted in 1996 found approximately 48 miles of roadside noxious weed infestations within the planning area. Monitoring in the form of noxious weed roadside surveys, botanical surveys, and monitoring related to other resource projects within the planning area continues to document the presence of noxious weeds, particularly Scotch broom.

BLM has implemented noxious weed control projects in the planning area primarily in the southeast portion to control roadside Scotch broom (cutting, pulling and grubbing), and meadow knapweed (pulling and grubbing). BLM has conducted 22 miles of roadside treatments for Scotch broom since 1996, and will likely need to conduct recurring treatments to manage noxious weeds (see Figure 4).

In addition to these roadside treatments, BLM has conducted Scotch broom cutting incidentally, in conjunction with reforestation vegetation management treatments (e.g., pre-commercial thinning, brush control), as required by BLM policy.

**Figure 4.** *Noxious weed control projects have included cutting Scotch broom along roadsides.*

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# CHAPTER 4

# Environmental Consequences

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# Introduction

This chapter summarizes the environmental consequences associated with each of the alternatives described in Chapter 2.

The following resources and/or critical elements of the human environment (as described in the BLM NEPA Handbook, H-1790-1, Appendix 5) are not present or would not be affected by any of the alternatives:

- Areas of Critical Environmental Concern (ACEC)
- Cultural resources
- Farm Lands (prime or unique)
- Hazardous or solid wastes
- Minority populations and low income populations
- Native American Religious Concerns
- Wild and Scenic Rivers
- Wilderness

Effects on threatened and endangered species, water quality, and wetlands, riparian zones, and floodplains are addressed in the analysis in this chapter. Effects on air quality would not be significant and have already been analyzed in the RMP EIS (USDI Bureau of Land Management 1994, pp. 4-10 - 4-14), as explained in Chapter 1 under Issues Considered, but Not Analyzed.

# Inadequate or Unavailable Information

We will always have incomplete knowledge of the ecology of terrestrial and aquatic ecosystems, and particularly about the development of late-successional forests (USDA and USDI February 1994, pp. 3&4-3 - 3&4-4). The following discussion of the analysis assumptions identifies incomplete information relevant to analysis of the issues, and how BLM will acquire additional information, where possible and necessary.

# Assumptions and Assessment Guidelines

We analyzed many issues in this EIS, especially those related to stand development and wildlife habitat, using stand modeling results from the Landscape Management System over a 100-year analysis period. The Landscape Management System (LMS) is a computerized set of software tools that integrates landscape-level spatial information, stand-level inventory data, and tree growth models to project changes through time across the landscape. LMS provides detailed stand-level analysis (see Figures 5 and 6) as well as landscape-level analysis. For the purposes of the modeling, the EIS assumes the year 2002 as the beginning of the 100-year analysis period.

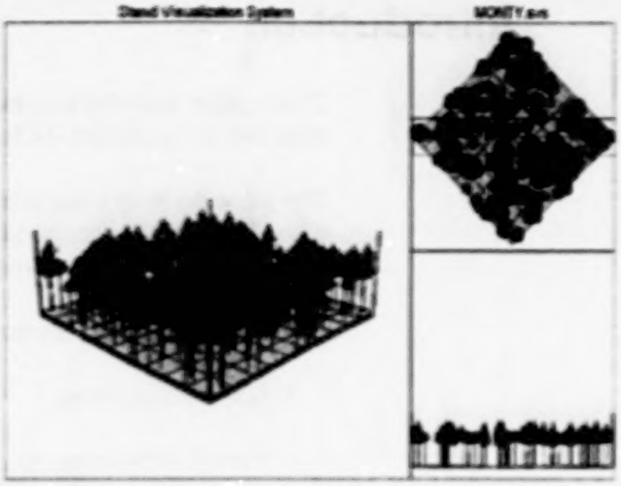

**Figure 5.** *LMS output showing visualization of stand structure.*

The tree growth model is based on the observed growth and development of fully-stocked natural stands, originally developed with the primary purpose of evaluating timber production. Applying this modeling to the growth and development of plantations for the purpose of evaluating ecological restoration is challenging. The modeling results in the first several decades are likely quite accurate, because it has been possible to calibrate the model based on actual observations of stand development. However, few if any differences in alternative restoration approaches are likely to become apparent in the first several decades. In most cases, differences among alternatives would not apparent until near the end of the 100-year analysis period.

The real value of the modeling results is in demonstrating the comparative outcomes of the alternatives. Absolute values should be interpreted with caution, especially past the first several decades. For example, the tree growth model appears to allow stands to grow and maintain too many large trees at densities too high for the site quality and stand conditions in the planning area (J. Comnick, personal communication, 2002). The model appears to overestimate the amount of live crown that trees would retain at high densities, thereby overestimating growth rates at high densities. Therefore, the modeling results probably slightly overestimate the development of large trees in unthinned stands.

Additionally, the starting stand inventories appear to slightly underestimate tree diameter and height. Starting stand inventories affect not only the stand growth and structure in the modeling, but also the revenues calculated for each alternative. The revenues are dependant on the volume of timber harvested, which is, in turn, extremely sensitive to the starting stand inventories. The apparent underestimation of starting inventories is likely causing an underestimation of revenues in all alternatives that include timber harvest. BLM is currently conducting a series of stand examinations in and near the planning area to calibrate the modeling. We may adjust the starting inventories and modeling parameters between the draft and final EIS based on the results of these stand examinations and other empirical data. Appendix B provides additional information about LMS and the modeling in this analysis.

We address the issues identified in Chapter 1 by the parameters described below. Additional information on the analysis methods and assumptions is available in the Upper Siuslaw LSR Restoration project file, which is available for review at the Eugene District Office.

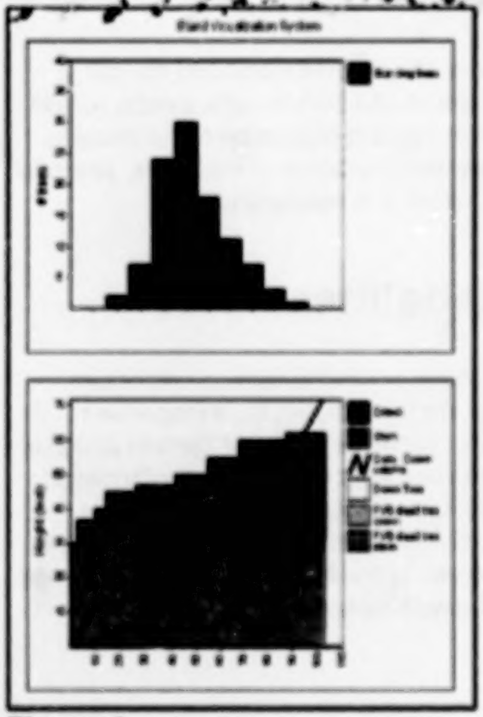

**Figure 6.** *LMS output charts showing tree diameters, heights, and crown sizes.*

## ISSUE 1: *How would road decommissioning and road management actions alter public access to BLM-managed lands?*

- *Miles of road not available for vehicle traffic*

We derived much of the information in this analysis from the road inventory of the planning area completed in 2002. The road inventory included a systematic analysis of the road network, including identification of the environmental risks to aquatic resources.

To understand the effects of road decommissioning on the public's ability to access BLM-managed land, it is necessary to define roads as either "legal public access" or "other." "Legal public access" is defined as either (a) roads for which BLM has acquired a public easement across private land; or (b) roads that begin on BLM-managed land that is legally accessible from state or county roads (see Figure 7).

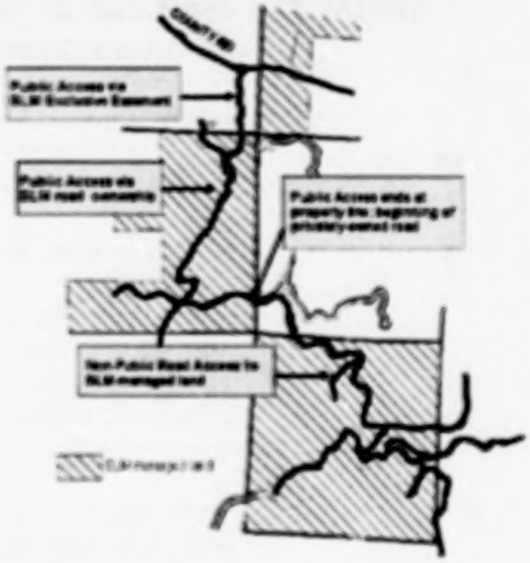
County Rd
Public Access via BLM Exclusive Easement
Public Access via BLM road [illegible]
Public Access ends at property line, beginning of privately-owned road
Non-Public Road Access to BLM-managed land
BLM managed land

**Figure 7.** *A sample of the ownership and public access status of a variety of roads that provide access to BLM-managed lands.*

"Other" roads include those for which BLM has not acquired a public easement for access. In such situations, the landowner has the legal authority to close the road to the public at any time, even if private landowners have allowed physical access across their land in the past. This may be true even where BLM has full maintenance responsibilities (i.e., "control") for the road. In addition, there may be roads on privately-owned land that are currently gated, that are not available for public use, or that are available only for short times during the year (e.g., hunting season).

The actions that may be taken to implement road decommissioning are described in Appendix A. Road decommissioning described here may include "decommissioning," "full decommissioning," or "obliteration" as defined in the Western Oregon Transportation Management Plan (USDI BLM 1996b). In this analysis, we assumed that only "non-shared" roads would be available for decommissioning. Even non-shared roads may be covered under existing right-of-way agreements with adjacent landowners, and decommissioning may require the consent of those landowners. In this analysis, we assume that adjacent landowners would consent to decommissioning of non-shared roads.

## ISSUE 2: *How much new road construction would be needed to implement restoration actions?*

- *Miles of new road construction*

We determined the estimated length of new road construction based on the average length of new road construction required for past timber sales in the Eugene District. These estimates vary among the different stand age-classes and are altered by some of the alternatives' design features. The estimates are described under this issue for each alternative.

## ISSUE 3: *What level of risk to existing late-successional forest would result from restoration activities?*

- *Fire: acres in Fuel Models 5, 10, and 12*
- *Bark beetles (stand level): acres with mortality; number of green trees killed*
- *Bark beetles (landscape level): qualitative analysis*

Forest disturbance processes in the planning area include fire, wind, insects, and disease (USDI BLM 1996a, p. II-23). The vulnerability of existing late-successional stands to disturbance by wind or disease is not likely to be affected by the restoration actions considered here (restoration actions which would affect the susceptibility of young stands to windthrow are addressed in Issue 4).

Restoration actions in young stands may affect the risk of fire and insect disturbance (specifically Douglas-fir bark beetle) across the landscape, including existing late-successional stands (USDA and USDI 1997, pp. 13-17). Therefore, we have evaluated the risk to existing late-successional forests from restoration activities based on the risk of wildfire and Douglas-fir bark beetle infestation.

The analysis measures fire risk by modeling fuel conditions over time. Specific quantities and qualities of surface fuels are assigned to specific "fuel models," which allow comparison of potential fire behavior and fire effects (Anderson 1982). The Fuels Report in the Upper Siuslaw LSR Restoration project file provides detailed information on this analysis and is available for review at the Eugene District Office. Four fuel models are relevant to the current and potential conditions in the planning area:

| | |
|---|---|
| • Model 5: | short shrubs (e.g., salal, swordfern, Oregon grape) that commonly make up the understory of forest stands; |
| • Model 6: | tall shrubs (e.g., oceanspray, hazel, vine maple) that establish in very young stands before canopy closure; |
| • Model 10: | timber with heavy dead and down fuels that occur in young, dense stands; |
| • Model 12: | slash that results from thinning or blowdown of stands. |

The analysis measures fire risk by assessing the acres of the stands currently 80 years old in Models 5, 10, and 12 as they move through time. Model 5 has low fuel loads and low potential fire effects. In contrast, Models 10 and 12 have high potential for crown fires and severe fire effects. The relatively few acres that are currently in Model 6 rapidly move into other models, largely unaffected by management actions, and the fire risk associated with Model 6 is similar to Model 5. Therefore, for simplicity of display, the analysis combines the acres in Model 6 with Model 5.

**Figure 8.** *Douglas-fir log with bark beetle infestations.*

We are able to predict the effect of restoration actions on populations of Douglas-fir bark beetle (*Dendroctonus pseudotsugae*) and subsequent Douglas-fir mortality at the stand level. In western Oregon, Douglas-fir bark beetle usually infest Douglas-fir trees >12" dbh (see Figure 8). A general rule of thumb proposed in several papers suggested that for every 10 Douglas-fir trees which are left as coarse woody debris, 6 live Douglas-fir trees would likely be killed in the subsequent two to three years (Hostetler and Ross 1996, Ross 2000). However, this rule of thumb was based primarily on trees larger than those proposed to be left as coarse woody debris in the alternatives in this EIS. Recent data from the Oregon Coast Range (Ross et al. 2001) showed that lower mortality rates, and estimated that the number of beetles produced from 10 down trees had the eventual potential to kill 4 similar-sized green trees. Therefore, this analysis assumes a mortality rate of 4 green trees killed for each 10 trees left as coarse woody debris. Tree mortality may be altered by a wide range of factors, such as the season of cutting, shading on the coarse woody debris, the vigor of attacked live trees, background beetle population levels, and weather conditions. If no additional coarse woody debris is created, bark beetle populations will generally return to normal three years after creation of coarse woody debris (Hostetler and Ross 1996).

Current Douglas-fir bark beetles populations in the planning area appear to be low, based on the very low numbers of trees killed in recent years. From 1985 through 2001, surveys detected from 0-135 trees killed by bark beetles per year over the entire planning area (<1 tree per 180 acres). However, bark beetle populations may increase dramatically if large amounts of coarse woody debris are created across the landscape, especially if combined with poor growing conditions that reduce tree vigor. Under these conditions, Douglas-fir bark beetles could damage existing late-successional forests (USDA and USDI 1997, pp. 15-16).

Epidemic bark beetle outbreaks are usually brief and localized in the Coast Range of Oregon, but are more common east of the Cascade Mountains (Hostetler and Ross 1996, Furniss and Carolin 1977). The most severe outbreak recorded in the Oregon Coast Range occurred in the 1950's. Wind storms during the winters of 1950-1951 and 1951-1952 blew down tremendous numbers of trees (Greeley et al. 1953). Within the planning area, historical aerial survey maps show that about two-thirds of the area had 40-80 acres of blowdown per square mile, and one-third had over 80 acres of blowdown per square mile. Much of the blowdown was in old stands with large trees, providing prime host material for the beetles. This blowdown, combined with the very dry growing seasons of 1951 and 1952 and a large number of scorched or dead trees from the forest fires of 1951, resulted in the most beetle-caused mortality ever recorded for the Oregon Coast Range. However, even these extreme conditions resulted in only an estimated 11,000 trees (0.42 per acre) killed by bark beetles from 1952-1954.

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The low intensity of tree mortality following such severe conditions establishes the relatively low risk of widespread or catastrophic tree mortality from bark beetles in the planning area. While the conditions that would be created by the alternatives differ from natural disturbances, the bark beetle outbreak in the 1950s provides a starting point from which to compare the alternatives on a landscape scale.

Because of the myriad factors influencing this landscape-scale effect, quantitative analysis is not possible here. Therefore, we have considered the landscape-scale effects of restoration actions on Douglas-fir bark beetle populations and subsequent tree mortality with a qualitative analysis, based on the best professional judgment of an expert federal entomologist (See Chapter 5, Consultation).

## ISSUE 4: *How would thinning affect development of late-successional forest structural characteristics?*

- *Acres of forest with late-successional structure*
- *Stand density (trees per acre, relative density)*
- *Stand stability (height : diameter)*

There are many descriptions of the structural characteristics of late-successional forests of the Douglas-fir forests region of the Pacific Northwest (Franklin et al. 1981; Old-Growth Definition Task Group 1986; Spies and Franklin 1988; Spies and Franklin 1991; USDA and USDI 1997, p. 57). However, late-successional forest structural characteristics may vary considerably across the region (Spies and Franklin 1991, p. 108), and the broad generalizations in these regional descriptions may be of limited value at finer spatial scales, such as this planning area. Therefore, for the purpose of this analysis, we developed criteria for late-successional forest structure based on local data (see Appendix C). Specifically, we examined stand inventory data that was collected from approximately 1,300 acres of late-successional stands that were harvested between 1985 and 1991 in or near the planning area (see Poage 2000, pp. 10-13). We used this data to a construct minimum threshold for late-successional structural characteristics:

| | |
|---|---|
| • density of large Douglas-fir (>32" dbh) | >3.25/acre |
| • density of very large Douglas-fir (>40" dbh) | >3.25/acre |
| • Coefficient of Variation (CV) of Douglas-fir diameters (>10" dbh) | >0.37 |
| • density of shade-tolerant conifers (>10" dbh) | >5.0/acre |

For analysis, we considered a stand to have late-successional forest structure if it meets any three of these four criteria. The data for local late-successional stands discussed above revealed that few stands simultaneously met all four criteria, but most met three of the four. Abundant large and very large Douglas-fir, abundant shade-tolerant conifers, and a wide range of tree diameters are consistent structural characteristics of late-successional forests (Spies and Franklin 1991) (see Figures 9 and 10). The Coefficient of Variation (CV, which is calculated as the standard deviation/mean average) of Douglas-fir tree diameters is a measure of how much the trees in a stand vary in diameter, rather than just describing the stand average or the extremes of the range. A higher CV corresponds to a wider variety of tree diameters. The density of shade-tolerant conifers (primarily western hemlock and western red-cedar) appears to be considerably lower in this planning area than the regional averages (Spies and Franklin 1991, p. 102; Poage 2000, pp. 31-43; Hibbs and Shatford 2001).

**Figure 9.** *Large Douglas-fir and an understory with hemlocks and cedars are typical of late-successional stands.*

We did not include in these criteria all possible structural characteristics of late-successional forests, most notably large snags and logs. The natural production of large snags and logs is difficult to model, in part because large snags and logs are more likely to be created by density-independent mortality (e.g., lightning, root rot, fire) than density-dependent mortality (e.g., tree competition). Tree growth models can effectively model density-dependent mortality, which tends to kill the smaller trees in the stand and thus creates only smaller snags or logs. Therefore, we have assumed that within the 100-year analysis period, sufficient large snags and logs will be present in the currently young stands only if they are created by active management. Given that the snag and coarse woody debris creation prescriptions in the alternatives were based on the levels of snags and logs in existing late-successional forests (USDA and USDI 1997, pp. 58-71), this assumption should be generally as accurate as a more sophisticated modeling approach.

This set of criteria provides a useful measure of the development of late-successional forest structure across the landscape, allowing the analysis to compare the number of acres that meet this minimum threshold over time and among alternatives. This analytical approach draws an absolute threshold – a stand either has late-successional structure or it does not. While this dichotomous approach is useful for landscape-scale analysis, it does not reflect the reality of stand development, in which late-successional stands exhibit continuous variability in structure (Franklin and Spies 1991).

Therefore, we also evaluate how stands currently 80 years old would develop under each alternative through time, and how this development compares with how existing late-successional stands developed. In addition to the late-successional structure threshold described above, we evaluate additional stand-level characteristics to describe the continuous development of stand condition under each alternative. The analysis measures the development of the stand density (in both relative density and trees per acre (TPA)) and the stand stability (in the ratio of tree height : tree diameter). Relative density is a measure of the growing space available to the average tree in a stand; higher values indicate more dense stands. (Curtis 1982) The ratio of tree height to tree diameter gives a measure of the mechanical stability of the tree; higher values indicates less stability. The stand average height : diameter ratio indicates the stability of the stand and the likelihood of catastrophic windthrow. (Lohmander and Helles 1987; Wilson and Oliver 2000).

In contrast to the past silvicultural regimen described in Chapter 3, most existing late-successional stands in the planning area appear to have developed at low tree densities with heterogeneous structure. The FEMAT Report describes generally the development of natural stands (USDA Forest Service et al. 1993, pp. IV-27 - IV-31; see also USDA and

**Figure 10.** *Late-successional stands characteristically have a wide range of tree diameters.*

USDI 1994, pp. B-1 - B-4). The RMP EIS also provides a general discussion of natural stand development and the effects of stand development on various resources (USDI BLM 1994, pp. IV-28 - IV-36; IV-51 - IV-53). The Siuslaw Watershed Analysis briefly describes likely future stand conditions across the watershed on both public and private lands (USDI BLM 1996a, pp. IV-2 - IV-5). The LSR Assessment describes natural forest successional stages in the LSR area (USDA and USDI 1997, pp. 36, 47-66). These analyses are incorporated here by reference.

Because the planning area lacks young, natural stands (i.e., stands that naturally regenerated following disturbances such as fire or windstorms, rather than timber harvest), our understanding of natural stand development must rely heavily on reconstructive studies, rather than direct observation. As with late-successional forest structure, natural stand development is highly variable and defies easy generalization (Spies and Franklin 1991; Hunter and White 1997; USDA and USDI 1997, pp. 54-55; Franklin et al. 2002).

However, recent studies that have sought to reconstruct the stand development of late-successional stands suggest some regional patterns (Tappeiner et al. 1997, Poage 2000; Winter 2000; Poage and Tappeiner 2002). Tappeiner et al. and Poage each examined a sample of western Oregon stands and found that large, old Douglas-fir trees in the Oregon Coast Range generally developed under low stand densities. In contrast, Winter found that an old-growth stand in western Washington had developed under initial high-density conditions. These contrasting findings reinforce that there may be multiple pathways to late-successional forest structure, and that the most likely or typical pathway may differ from one region to another.

Data from local late-successional stands within and near the planning area are consistent with the findings of Tappeiner et al. and Poage, and support the conclusion that late-successional stands in this planning area typically developed under initial low densities (see Figure 11). Late-successional stands in the planning area average 47 TPA of trees >10" dbh (generally ranging from 20 to 80 TPA). The relative density of Douglas-fir in local late-successional stands is low, averaging 32 (generally ranging from 20 to 50). In comparison, Matrix stands are often thinned when relative density reaches 50 to 60 and are thinned to relative density of 35 to 40 (USDI BLM 1995, pp. 202, 205); thus most local late-successional stands have lower Relative Densities than the post-treatment density under typical thinning prescriptions. Appendix C summarizes this data on local late-successional stands.

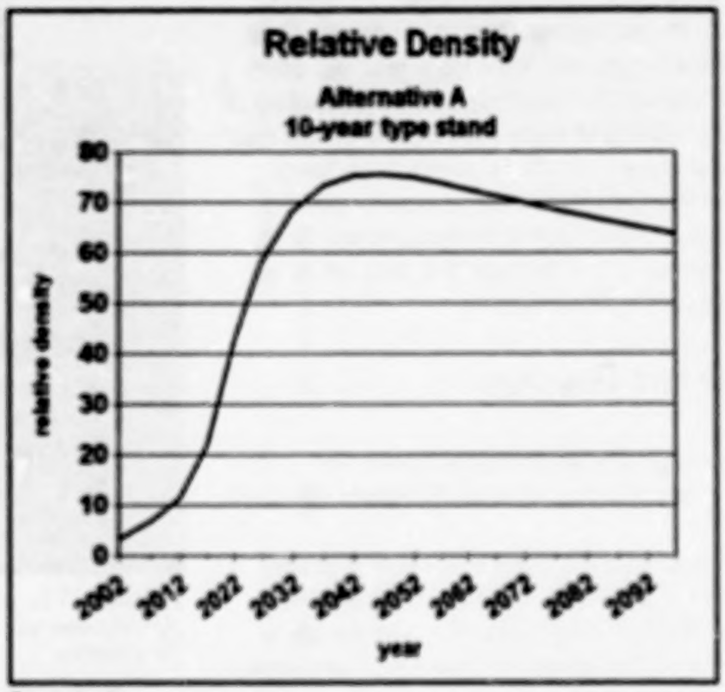
**Figure 11.** *Many old-growth stands in the planning area appear to have developed under low densities*

## HOW TO READ THE GRAPHS

The following section explains how to interpret the graphs related to forest structure.

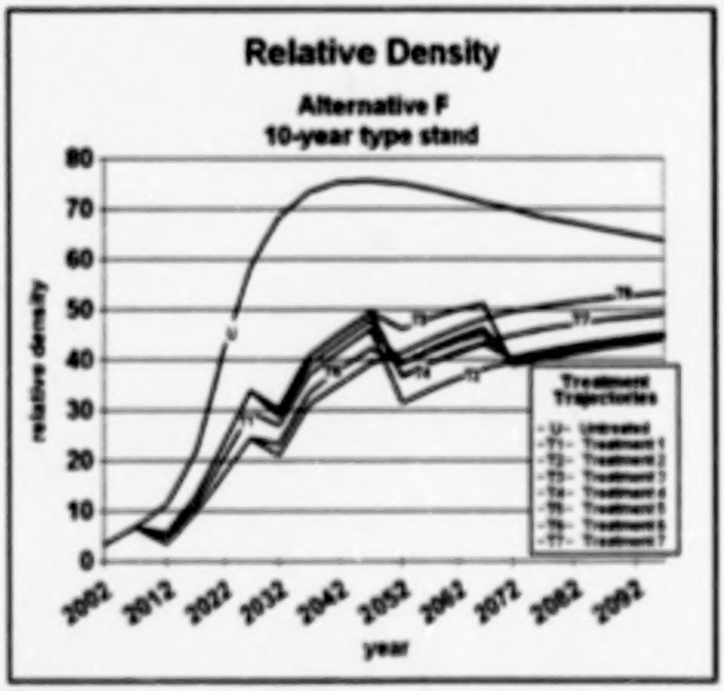
For each alternative, the analysis presents a set of graphs on trees per acre, relative density, and height:diameter ratio for each "type" stand "trajectory" over time. Modeling forest development across the landscape required simplifying the stands into a series of "type" stands: a generalized stand condition for a given age class and its typical management history, for example, "40-year old stands that have been pre-commercially thinned" (see Appendix B). The stand "trajectories" are the type stands combined with specific treatments that would be applied under a given alternative.

For example, there is only one trajectory for each type stand in Alternative A, because there are no treatments. Graph 3 shows the relative density of the single trajectory of the 10-year type stand in Alternative A.



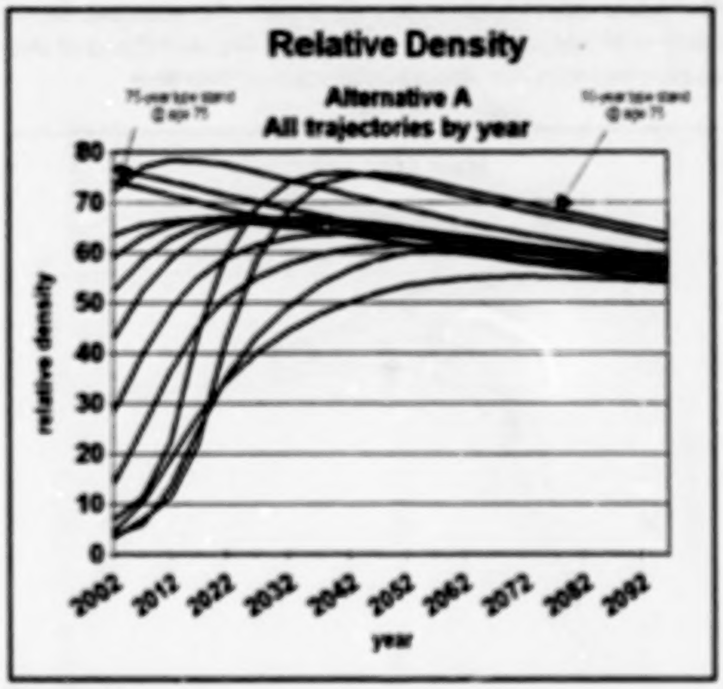
**Graph 3.**

In the action alternatives, there are often multiple trajectories for each type stand because there are varied treatments. For example, in Alternative F, there are eight trajectories for the 10-year type stand: the untreated stands and seven different treatments. Graph 4 shows the relative density of the eight trajectories of the 10-year type stand in Alternative F.



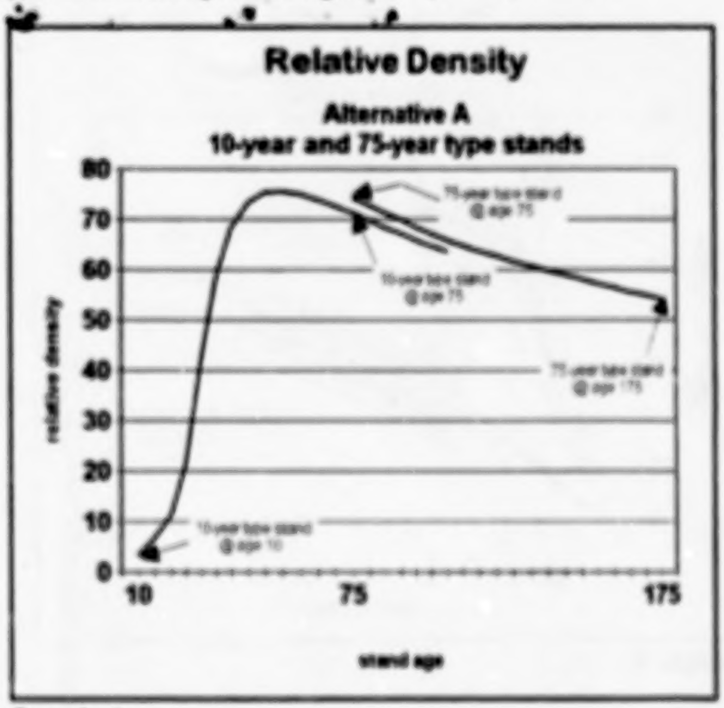
**Graph 4.**

Presenting data by the year, as shown in Graph 5, would make it difficult to compare the stand characteristics of trajectories at the same type stand.



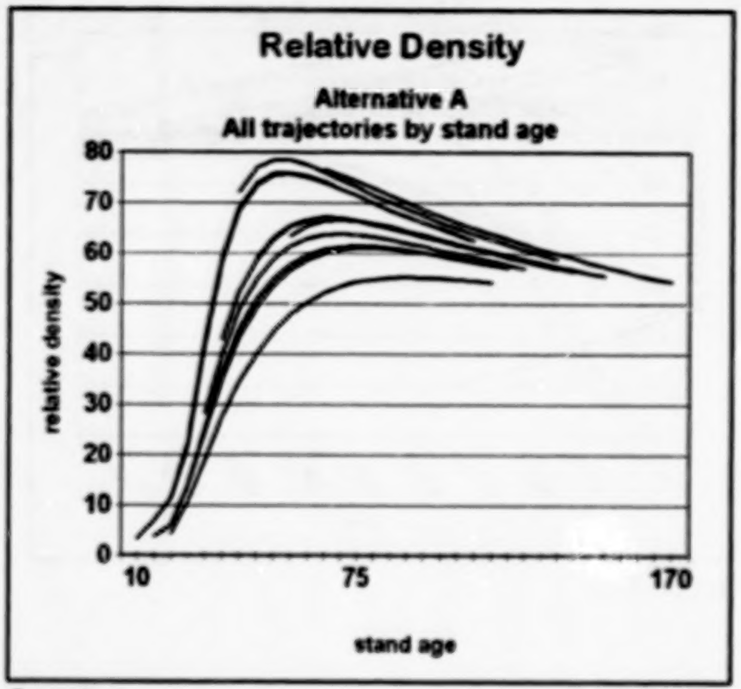
**Graph 5.**

If we present the data by stand age instead of year, it is easier to compare the characteristics of different trajectories. Treatment trajectories for the various type stands begin and end at different points along the x-axis of the graph. For example, Graph 6 shows the relative densities of the 10-year and 75-year old untreated type stands. The analysis tracks the 10-year old type stand from age 10 to age 110, and the 75-year old type stand from age 75 to age 175.



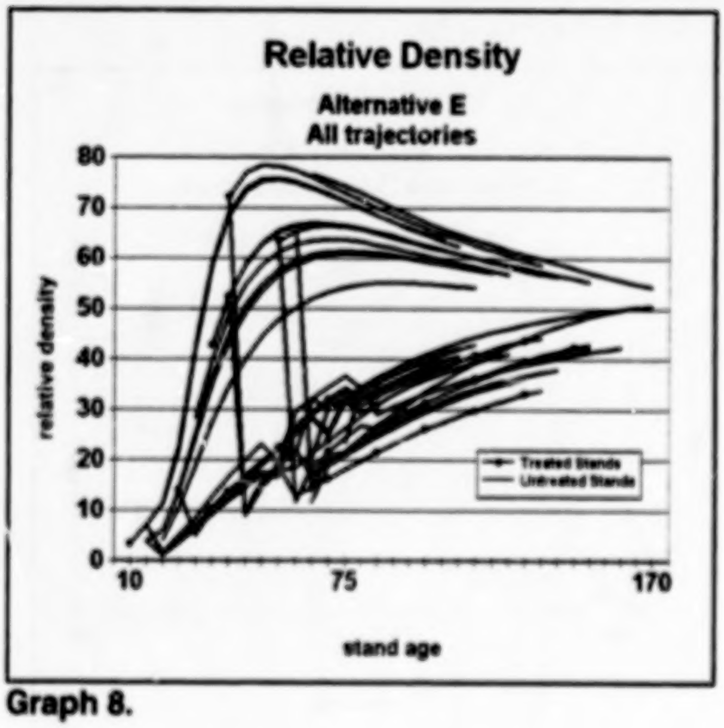
**Graph 6.**

When all the trajectories for a characteristic are portrayed, many of the graphs become complex. We present these graphs to depict the overall pattern of the suite of stand trajectories for each alternative over time, and do not intend these graphs to convey specific data values for specific trajectories. For example, Graph 7 shows the relative density of all trajectories in Alternative A. The usefulness of this graph is that is shows that all trajectories develop a similar pattern over time.



**Graph 7.**

In contrast, Graph 8 shows that treated and untreated stands develop very different patterns of relative density under Alternative E.



**Graph 8.**

## ISSUE 5: *What are the effects of restoration activities on marbled murrelet habitat?*

- *Acres of suitable nesting habitat*
- *Acres of target habitat conditions*

### Suitable Nesting Habitat

The FWS (1996) has described stands in which marbled murrelets have been found to nest include at a minimum the following criteria:

- at least one tree per acre ≥32"dbh with a branch at least 5" diameter.

Branches of 5" diameter represent a minimum for marbled murrelet nesting, and larger branches increase the likelihood of successful nesting, particularly between 5" and 10". Every additional inch of branch diameter lessens the chance of the murrelet egg rolling off the branch.

We assume in this analysis that eventual branch size is a result of the overall lifespan of the branch. We used tree crown ratios and height growth from the LMS model to calculate an expected branch life. We assumed tree height growth to be linear over the 100-year analysis period, and branch growth at a constant growth rate of 0.05"/year (radial). These assumptions probably slightly underestimate branch growth in low density stands and overestimate branch growth in high density stands (Kintop, unpublished). Branch size estimates should be used only for demonstrating the comparative outcomes of the alternatives. Absolute values should be interpreted with caution, given the simplifying assumptions needed for analysis.

### Target Habitat Conditions

We developed a description of target habitat condition as part of this analysis to describe good quality nesting habitat, rather than the minimum conditions of suitable nesting habitat. The descriptions of stands containing marbled murrelet nests presented in Hamer and Nelson 1995 substantially, but not completely, parallel the criteria we used in this analysis for late-successional forest structure: marbled murrelets prefer to nest in stands that have large trees with large branches, multiple canopy layers, and moderate canopy closure. Therefore, we consider target habitat conditions for marbled murrelets as those stands meeting all three of the following criteria:

| | |
|---|---|
| • density of large Douglas-fir (>32" dbh) | >1.0/acre |
| • density of shade-tolerant conifers (>10" dbh) | >5.0/acre |
| • Coefficient of Variation (CV) of Douglas-fir diameters (>10" dbh) | >0.37 |

## ISSUE 6: *What are the effects of restoration activities on northern spotted owl habitat?*

- *Acres of dispersal habitat*
- *Acres of suitable habitat*
- *Acres of target habitat conditions*

In this analysis, we evaluate dispersal habitat, suitable habitat, and target habitat conditions. Dispersal and suitable habitat are customarily evaluated in consultations with the FWS. We developed a description of target habitat conditions as part of this analysis to describe good quality habitat, rather than the minimum conditions of suitable habitat.

## Dispersal Habitat

The FWS defines dispersal habitat as habitat which supports the life needs of an individual animal during dispersal (USDA and USDI February 1994, Appendix G, p. 16), but dispersal habitat does not necessarily provide nesting and foraging habitat for a self-sustaining owl population. We consider stands as dispersal habitat if they meet both of these criteria:

- stands with ≥11" average dbh
- stands with ≥40% canopy closure.

These criteria match those described repeatedly in referenced sources (USDA and USDI February 1994, Appendix G, p. 16; USDI Fish and Wildlife Service 1992b, p. 121; Thomas et al. 1990, p. 310). Dispersal habitat generally develops at about age 40 in stands in the planning area.

## Suitable Habitat

Suitable habitat provides at least minimum conditions for nesting, roosting, and foraging habitat. We consider stands as suitable habitat if they are >80 years old or meet the following three criteria:

- ≥1 tree per acre ≥38"dbh (nesting)
- ≥40% canopy closure (roosting)
- ≥8 sq. ft. basal area of shade-tolerant conifers, as a measure of canopy layering (foraging)

We defined these criteria in part based on minimum values from Thrailkill et al. 1998, which reported on the demography and habitat associations of spotted owls inhabiting LSR 267 for 1990-1995. We based the threshold value of shade-tolerant conifer basal area on empirical measurements of existing stands in the planning area that are considered foraging habitat.

## Target Habitat Conditions

Target habitat conditions for spotted owls parallel the descriptions of late-successional forest structure. Thrailkill et al. 1998 found that spotted owls preferred stands with a high amount of structural heterogeneity, including a broad range of tree diameters, large trees in the overstory, a high density of shade-tolerant conifers and hardwoods, intermediate levels of canopy closure, and canopy layering. Therefore, we use the definition of late-successional structure for target habitat conditions (see Issue 4).

## ISSUE 7: *What are the effects of restoration activities on coho salmon habitat?*

- *In-stream structure: miles of stream with stable structures by stream order groups (1-2, 3-5)*

- *Acres of riparian area (<100' from stream) that contain sufficient large conifers to provide large woody debris to streams*
- *Water quality: cubic yards/year of chronic and episodic sedimentation*
- *Miles additional habitat made available by removal of barriers*

## In-stream Structure

In this analysis, we measure stream complexity by the miles of stream with stable structures that would be created. The analysis considers in-stream structures stable if they are cabled or include >16 logs/mile that are >24" diameter (see Figure 12). We assume that a 50-year flood would remove uncabled logs ≤24" diameter in 3rd-order streams and larger, based on observations of the effect of the 1996 floods in the Siuslaw River Basin. We assume that logs would not be removed by a 50-year flood in smaller streams.

## Riparian Stands

We developed the target number of large conifers in the riparian area (<100' from streams) from the quantity of large woody debris in the Oregon Department of Fish and Wildlife (ODFW) Riparian Habitat Benchmarks (Thom et al. 2000).

- ≥13 conifer trees/acre ≥24" dbh
- ≥13 conifer trees/acre ≥32" dbh

We developed these criteria from the ODFW benchmark for "key pieces" of large woody debris in the streams, not from the benchmark for desirable densities of large conifers in the riparian area. The ODFW benchmark for density of large conifers in the riparian area is so high as to raise questions of its reliability: none of the local late-successional stands exhibit such high density of large trees (see Appendix C). Regardless, that benchmark is useless in comparing alternatives in this analysis, because no stand develops such densities under any alternative in the 100-year analysis period. Instead, we measure when the riparian area can provide a sufficient source to meet the benchmark for key pieces (≥24" dbh) of large woody debris. Given that trees =24" dbh represent a minimum size for key pieces, we also measure when the riparian area can provide a source of larger pieces (≥32" dbh) that would provide greater stability to in-stream structure. We measure the time when the riparian stand would have twice the number of trees of the target size to ensure that no more than half of the largest cohort would needed for large woody debris to reach the riparian habitat benchmark.

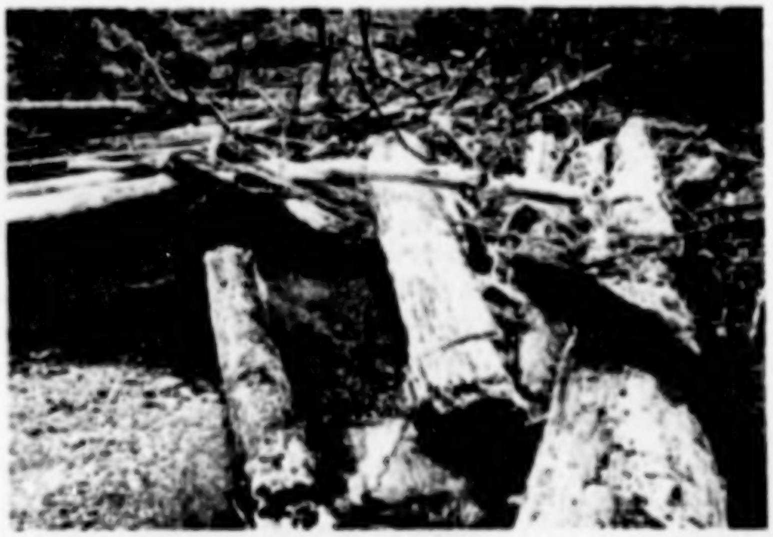


**Figure 12.** *Large logs are needed to provide stable structures in streams.*

In this analysis, we do not address the effect of converting hardwood-dominated riparian areas to conifers. The Siuslaw Watershed Analysis and LSR Assessment discuss the use of silviculture in converting hardwood-dominated riparian areas to conifers to provide a better supply of large woody debris to streams and thereby improve fish habitat (Watershed Analysis, pp. IV-1; V-1; USDA and USDI 1997, p. 45). However, the planning area has such a small amount of hardwood-dominated riparian areas (approximately 1% of the planning area) that there would be no measurable effect on coho salmon habitat from the different approaches in the alternatives.

## Sedimentation

Sources of fine sediment delivery to the stream system include chronic delivery from existing road surface erosion, episodic delivery from landslides resulting from culvert failures during storm events, and temporary pulses of sediment from culvert replacement or removal, in-stream restoration projects, and new road construction.

In this analysis, we assume that application of best management practices would eliminate the potential for sedimentation to streams from yarding of timber, which is consistent with the findings of the watershed analysis (USDI BLM 1996a, pp. II-7 - II-8).

We also assume that hauling of timber from the thinning proposed in some of the alternatives is unlikely to result in significant sedimentation. There is little potential for significant sedimentation from timber hauling in the planning area because many mainline haul routes adjacent to streams are paved, including the Siuslaw County Road, Oxbow Creek Road, Buck Creek Road, and Doe Creek Road. Outside of the planning area, major access roads are also paved, including Lorane Highway and Wolf Creek Road. Additionally, much of the timber hauling would occur during the summer, because many thinning operations would be seasonally limited by temporary roads, which would further reduce the potential for cumulative sedimentation to streams.

The absolute values in the analysis of sedimentation should be interpreted with caution for a variety of reasons. Although the road data collected in the 2002 road inventory is of high quality, the sediment model simplifies a complex road system and lacks erosion factors from the planning area. The estimates of sediment yield from other sources are approximate and rely on coarse averages. However, any estimation errors would be uniformly applied across the alternatives. The primary value of this analysis is in demonstrating the relative contribution of the various sediment sources. Appendix D provides additional explanation of the sedimentation analysis assumptions and methodology.

**Road erosion:** We estimate sediment delivery from existing road surface erosion based on field observations in 2002 road inventory and the Washington Standard Methodology for Conducting Watershed Analysis (Washington Forest Practices Board 1995). Because factors used in the Washington methodology were based on a combination of studies performed in the Idaho Batholith area and elsewhere, we made one deviation to the traffic factor to more accurately reflect the lithology of the planning area. We calibrated the calculations in this analysis to data from unpublished research performed in southwestern Washington, which is expected to more accurately reflect sediment yields in the planning area (Sullivan and Duncan 1980).

**Culvert failure:** The 2002 road inventory identified 73 culverts that are currently at risk of failure. In this analysis, we assume that these culverts would fail within the 100-year analysis period if not replaced or removed. We calculated the amount of sediment that would be delivered from these culverts if they fail based on estimated average values for the depth of fill, the active channel width, and the road prism width. This estimate does not include mass wasting from debris flows or any other catastrophic road drainage problem.

**Culvert replacement:** Replacement or removal of culverts would cause a temporary pulse of sediment, but few studies have quantified this sediment delivery. Monitoring results from the Lolo National Forest, Montana, indicate that between 1 to 2 cubic yards were introduced into the stream during and after culvert removal (Lolo, 2000). However, empirical observations in the planning area indicate that little sedimentation has been observed during culvert replacement or removal (N. Armantrout, L. Poole, S. Steiner, C. Vostal, personal communication, 2002). Best management practices, such as dewatering, straw bales, and numerous bio-engineering techniques, appear to reduce sediment production substantially. Therefore, we estimate that 1 cubic yard would be delivered to the stream channel during each culvert replacement or removal. We assume that culverts would be replaced or removed at an even pace over the ten-year plan period.

**In-stream projects:** During in-stream restoration projects, channel bank and bed disturbances can lead to sedimentation, but no studies have quantified this sediment delivery. Based on empirical observations of past in-stream projects in the planning area, we estimate that 0.25 cubic yards of sediment would be created per restoration site (N. Armantrout, L. Poole, S. Steiner, C. Vostal, personal communication, 2002). We assume that in-stream restoration projects would occur at an even pace over the ten-year plan period.

**New road construction:** In this analysis, we assume that if new road construction would cross streams, it would contribute sediment to the stream system. We estimate the number of stream crossings required based on the average number required in past timber sales: one stream crossing per 9,500' of new road construction (see Issue 2). Because the stream crossings would be temporary and removed before the onset of winter rains, we estimate that the sediment delivery from stream crossing construction and removal would be approximately the same as produced by culvert replacement: 1 cubic yard/crossing.

## Barriers

We determined the effect of the removal of barriers on available fish habitat by field survey of streams above barriers to assess potential habitat conditions.

## ISSUE 8: *How would restoration activities affect the presence and spread of noxious weeds?*

- *Miles of new road construction*
- *Miles of road decommissioned*

The Siuslaw Watershed Analysis and the LSR Assessment highlight the importance of roads as the primary vector for the spread of noxious weeds in the planning area (USDI BLM 1996a, p. II-40; USDA and USDI 1997, p. 28). The LSR Assessment explained that forest establishment and growth reduces or eliminates populations of most of the weeds of concern in the planning area. Thus, differences among the alternatives on effects to noxious weeds are generally reflected by the differences in the net change in road mileage in the planning area.

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## ISSUE 9: *What would be the economic effects of restoration activities?*

- *Months of contract work created*
- *Dollars (present day) of revenue generated*

In this analysis, we calculated average production rates for the types of restoration treatments outlined under the alternatives based on past experience with similar contracts. We measured the amount of contract work created in months of work, based on 20 work days per month.

We estimate that silvicultural contract work can be completed at a rate ranging from two acres per worker per day in the youngest stands to one acre per worker per day in older stands.

We estimate that a two-person crew can decommission a mile of road in four days, based on past experience with road decommissioning. A wide variety of factors, such as fire restrictions, seasonal restrictions to protect northern spotted owl nesting, number of culverts, amount of fill, and terrain, influence the length of road that could be decommissioned in a single season.

All action alternatives would replace 10 culverts, based on the recommendations of the 2002 road inventory. Given the culvert locations, depth of fill, other environmental characteristics of the sites and culvert design, we estimate that each culvert would take a three-person crew seven days to install.

We estimate that one mile of in-stream structure construction could be completed in 60 days; that a two-person crew could complete one mile of riparian falling in three days; and that a three-person crew could pull over and yard two trees per day.

We calculated revenues generated from the sale of cut trees based on current prices. We reduced the gross revenues by the costs needed to remove the cut trees. We did not discount the costs and revenues to the present because of the uncertainty of actual project dates. We assume a selling price of $320 per thousand board feet (MBF) and typical timber removal levels from 10 - 20 MBF per acre, depending on the stand age and specific thinning prescription. This removal level assumes that approximately three-fourths of the cut trees would be removed and one-fourth would be left as coarse woody debris.

The analysis does not attempt to account for indirect economic benefits resulting from restoration, such as economic benefits associated with increased fish populations, recreation opportunities, or special forests products.

## ISSUE 10: *What are the costs of restoration?*

- *Dollars (present day) of contract costs – labor and material*
- *Dollars (present day) of BLM staff cost – project planning, layout, contract administration*

Costs of restoration include actual contract costs (the amount BLM would pay to a contractor to perform specified work) and BLM staff costs (reconnaissance, project planning, field surveys, environmental clearances, unit layout, and contract administration). As stated above, we did not discount costs and revenues to present because of uncertainty in determining actual project dates.

**Figure 13.** *Contract costs for restoration actions such as culvert replacements were based on past experience with similar contracts.*

We calculated contract costs for non-commercial silvicultural treatments based on current contract prices for similar treatments throughout the district, with adjustments for expected mitigation work or where the required work would be more difficult. These costs would vary from $110 per acre to $200 per acre, depending upon the level of work per acre. In a few circumstances, we estimated costs as high as $500 per acre where extensive handwork for mitigation would be expected. We imbedded contract costs for silvicultural treatments that would include removal of cut trees within the revenues from the sale of cut trees, and the revenues described below are the remainder after those costs were deducted. Costs for removal may be as high as $1,600 per acre.

We calculated BLM staff costs for silvicultural treatments based on past experience with similar contracts. We assume that non-commercial silvicultural projects would be prepared and administered at a rate of 200 to 300 acres per BLM work-month and an average work-month cost of $5,000. For silvicultural treatments in which commercial removal would be anticipated, we assumes the district average preparation and administration cost for FY 2000 through FY 2002 expenditures: $150 of BLM staff costs per MBF of timber removed.

We calculated contract costs for in-stream projects, road decommissioning, and culvert replacements based on current contract prices for similar work throughout the district (see Figure 13). We estimated BLM staff costs for these treatments based on past experience with similar contracts. As with silvicultural treatments, we assume an average BLM work-month cost of $5,000.

# Impacts of the Alternatives

The analysis of impacts is organized by alternative, with a discussion of how the alternative would respond to each issue. In the discussion of each issue, we present the direct, indirect, and cumulative effects together. This organization best reflects the interrelated nature of many of the issues, and acknowledges that the distinction between direct, indirect, and cumulative effects is indistinct for many of the issues.

The Council on Environmental Quality (CEQ) regulations require that the analysis of environmental consequences discuss "...any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented." (40 CFR 1502.16). We address these topics below as part of the discussion of the environmental consequences related to each issue.

The CEQ regulations (40 CFR 1502.16) also require a discussion of "possible conflicts between the proposed action and the objectives of Federal, regional, State, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned." This EIS incorporates by reference the discussion in the RMP EIS and the Northwest Forest Plan Final SEIS concerning conflicts with other plans (USDI BLM 1994, pp. xvii, 4-135 - 4-137; USDA and USDI, February 1994, pp. 3&4-319 and 3&4-320, and Appendix D). Implementing the decisions in the RMP regarding LSR and Riparian Reserve management, as proposed in all action alternatives of this EIS, would not alter the conclusions of the RMP EIS regarding the possible conflicts with other plans. The management direction in this EIS applies only to BLM-administered lands where state and local land use plans, policies, and controls have little application, and has no application to tribal and Indian-owned lands.

# ALTERNATIVE A

## No Action

Alternative A would take no management actions except those specifically required by the RMP, or by law or policy.

### ISSUE 1: *How would road decommissioning and road management actions alter public access to BLM-managed lands?*

Under Alternative A, there would be no large-scale or long-term program of road decommissioning on BLM-managed land within the planning area. The only anticipated road closures would be in response to natural events, such as fire or landslides, that would require a road to be closed to protect public safety.

There are currently 12 miles of road that are "passively" decommissioning; that is, because of lack of regular maintenance, the roads are becoming impassable over time (see Chapter 3). It is reasonably foreseeable that a small number of additional roads would passively decommission, continuing the current trend.

Public access to private timber lands would likely continue to decrease under all alternatives (see Chapter 3).

**Key Points**

- Public access to BLM-managed lands would not change because roads would not be closed or decommissioned.

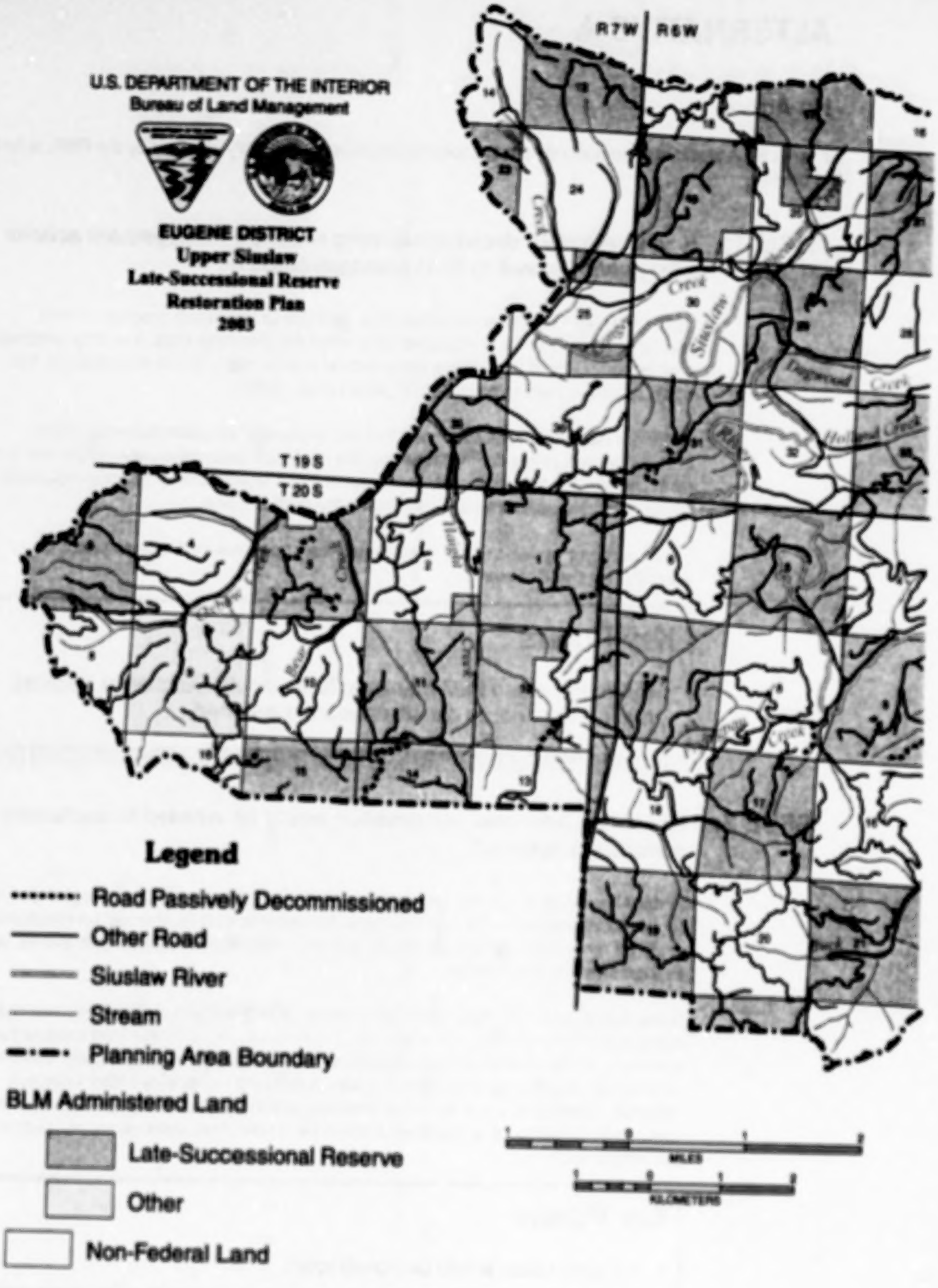
### ISSUE 2: *How much new road construction would be needed to implement restoration actions?*

Under Alternative A, no new road construction would occur on BLM-managed land in support of restoration. It is not reasonably foreseeable that BLM would be constructing roads for other management purposes, except in response to catastrophic events, such as extensive fire or windthrow.

Some new road would likely be constructed by private timber companies across BLM-managed land to access private land, but the amount of future new road construction is unknown. In the past three years, less than one mile of new road has been constructed on BLM-managed land in the planning area in response to private timber company requests. Therefore, it is reasonably foreseeable that actions taken by private timber companies would result in less than a half-mile of new road construction per year in the planning area.

**Key Points**

- No new roads would be constructed.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U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management
EUGENE DISTRICT
Upper Siuslaw
Late-Successional Reserve
Restoration Plan
2003
Creek
Siuslaw
River
Dogwood Creek
Holland Creek
T 19 S
T 20 S
Creek
Legend
Road Passively Decommissioned
Other Road
Siuslaw River
Stream
Planning Area Boundary
BLM Administered Land
Late-Successional Reserve
Other
Non-Federal Land
1 0 1 2
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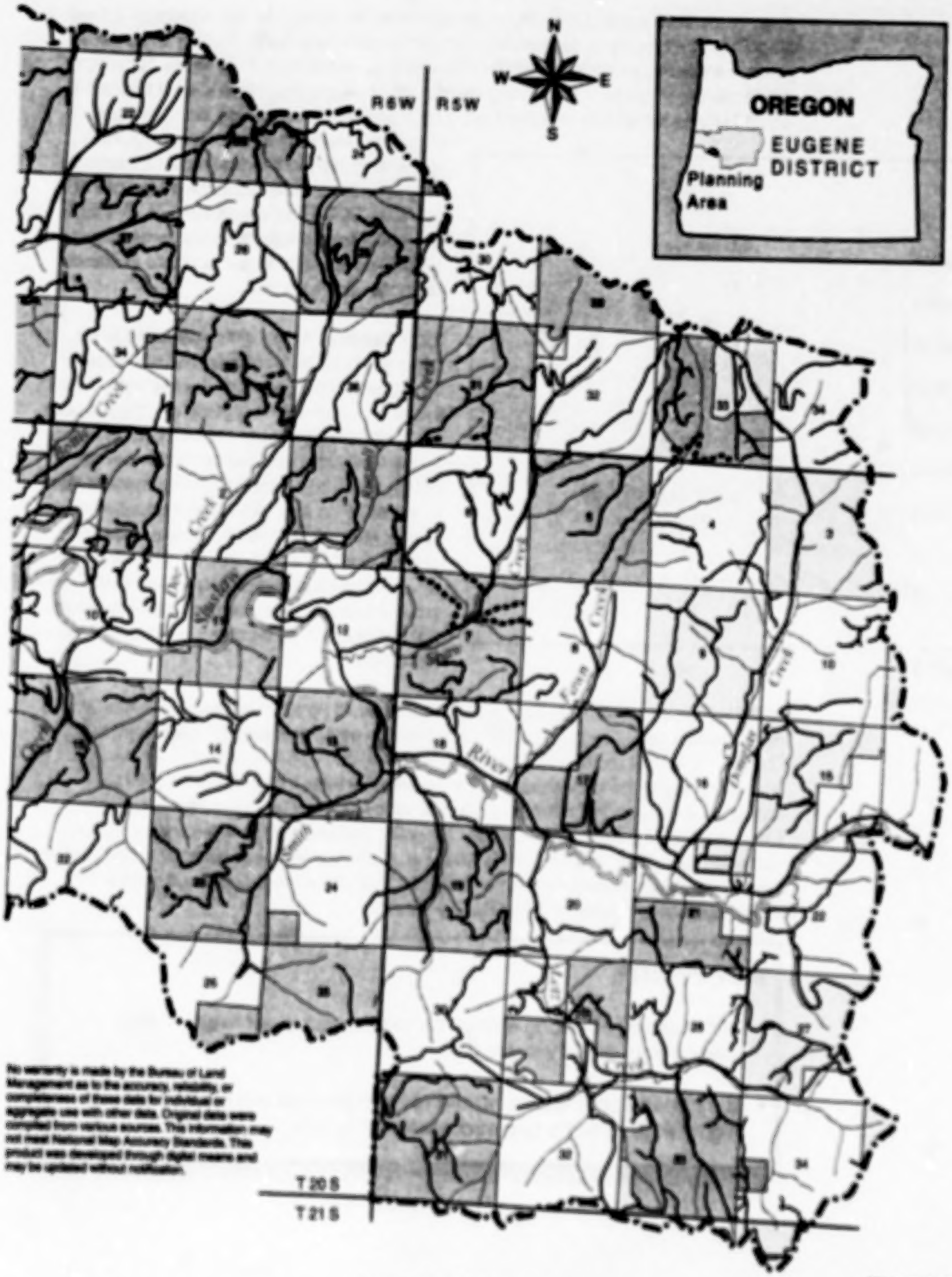
## **Map 1:** Alternative A - Road Decommissioning



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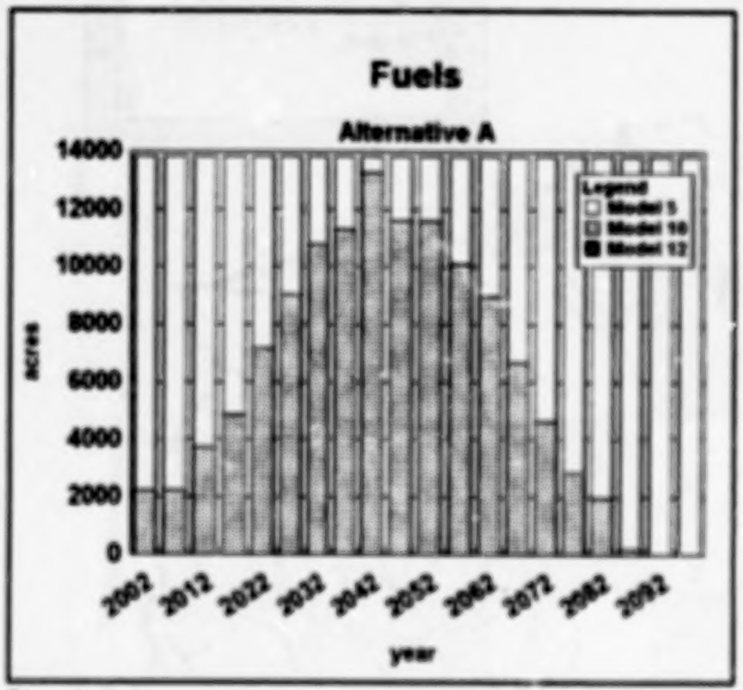
## ISSUE 3: *What level of risk to existing late-successional forest would result from restoration activities?*

**Fire:** In the absence of active stand management, the portion of the landscape in Fuel Model 10 would increase dramatically and persistently (see Graph 9). For about 40 years, the majority of stands currently ≤80 years old would be in Fuel Model 10, which would present a substantial and long-lasting risk of severe fire. Fires in Fuel Model 10 would likely be hot and severe and have a high potential for crowning and burning out of control. Maintaining such a large portion of the landscape in this fuel model for such a long period of time would pose a high risk of catastrophic fire that would damage existing late-successional forests and slow development of late-successional forest structure in stands currently ≤80 years old.



Graph 9

**Bark Beetles:** At the individual stand scale, there would be no increased risk of Douglas-fir bark beetle damage under Alternative A. Within the stands currently ≤80 years old, there would be minimal or low levels of tree mortality caused by bark beetles, because no coarse woody debris would be created by active management. In the absence of active stand management, stands currently ≤80 years old would develop at high densities (see Issue 4). Tree mortality would be gradual and largely limited to the smaller trees in the stand and therefore would not contribute to an increase in the bark beetle population.

At the landscape scale, bark beetle populations would continue to respond to natural disturbances caused by wind or fire. Bark beetles would maintain their low population levels in trees stressed by root disease and windthrown or broken trees, with small, temporary population increases after severe wind events. In the absence of large, natural disturbances, the number of trees killed by bark beetles would remain quite low in the planning area, and bark beetles would not pose a high risk to existing late-successional forests. If a natural disturbance, such as a severe windstorm, occurs within the planning area, especially in older stands, some of the remaining large trees within those stands would likely be killed by bark beetles.

### KEY POINTS

- The majority of young stands would present a substantial and long-lasting risk of severe fire.
- Bark beetle populations would remain low and would not pose a high risk to existing late-successional forests.

## ISSUE 4: *How would thinning affect development of late-successional forest structural characteristics?*

Under Alternative A, BLM would conduct no active stand management. All stands currently ≤80 years old would continue on their existing developmental pathway, which has been set by the past silvicultural regimen.

No stands currently ≤80 years old would meet the criteria for late-successional forest structure within the 100-year analysis period (Graph 38). Although some stands would eventually develop Douglas-fir trees >40" dbh, none of the stands would develop sufficient shade-tolerant conifers or an adequate range of tree diameters. High stand densities would also slow the development of very large Douglas-fir trees compared to all of the action alternatives. Snags and woody debris would originate mostly from small-diameter trees as a result of density-dependent mortality.

Even though stands currently ≤8.0 years old in the planning area are at different ages and developmental conditions (see Figures 14 and 15), nearly all would converge towards a single developmental pathway in the absence of disturbance such as windstorm or fire (see Figure 16). All of these stands would still be very dense in 100 years.

**Figure 14.** *Under Alternative A, this 10-year-old stand that has not been thinned would develop similar structure in 100 years to the stand in Figure 15*

**Figure 15.** *This 15-year-old stand has been pre-commercially thinned to a wide spacing.*

At the end of the 100-year analysis period, these stands would have 60-100 TPA and high relative densities – from 55 to 65, above the point at which density-dependent mortality occurs (see Graphs 10 and 11). As these stands age, individual tree growth would slow. This stage is described as the "stem exclusion" stage, in which stand density declines, stand mortality increases, and stand differentiation begins (Oliver and Larson 1990).

The stands currently ≤80 years old have less variation in structure than natural stands (USDA and USDI 1997, p. 36). If left untreated, these stands would not differentiate as rapidly as natural stands, and would most likely enter an extended period of high density and uniform structure that would extend beyond the 100-year analysis period. This would result in less differential competition between neighboring trees, and relatively little difference in individual tree growth rates. As a result, stands would "stagnate." The entire population of trees would slow in growth, and the average stand diameter would grow less rapidly than natural stands (Smith and Reukema 1986, Tappeiner et al. 1997, Poage 2000, Poage and Tappeiner 2002). For example, Figures 17 and 18 illustrate the development of the 30-year-old type stand, showing its current condition and the high-density uniform structure of the stand at the end of the 100-year analysis period.

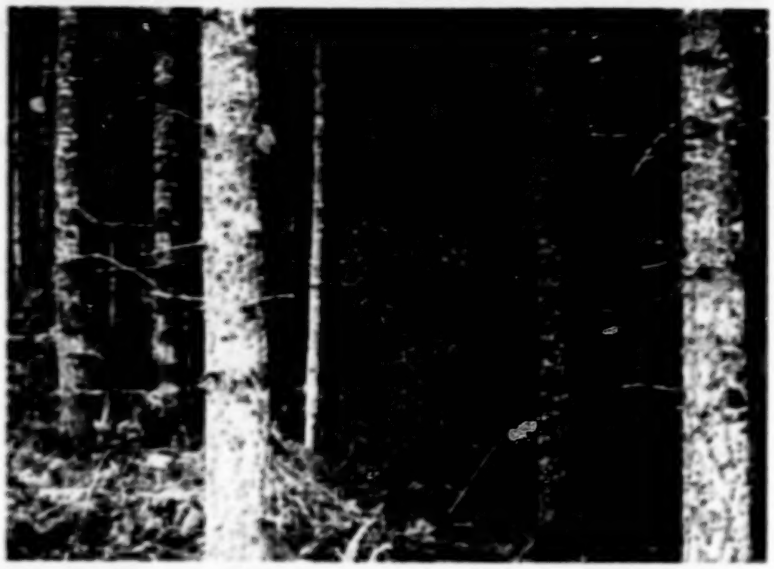
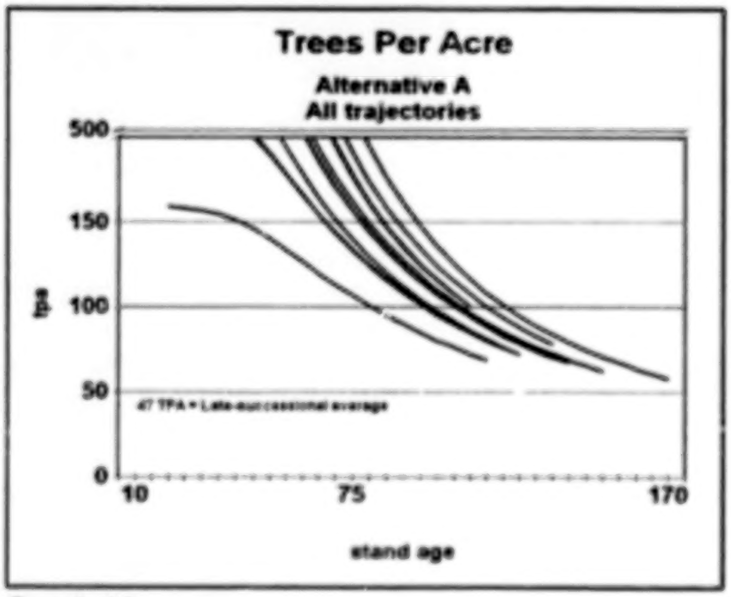
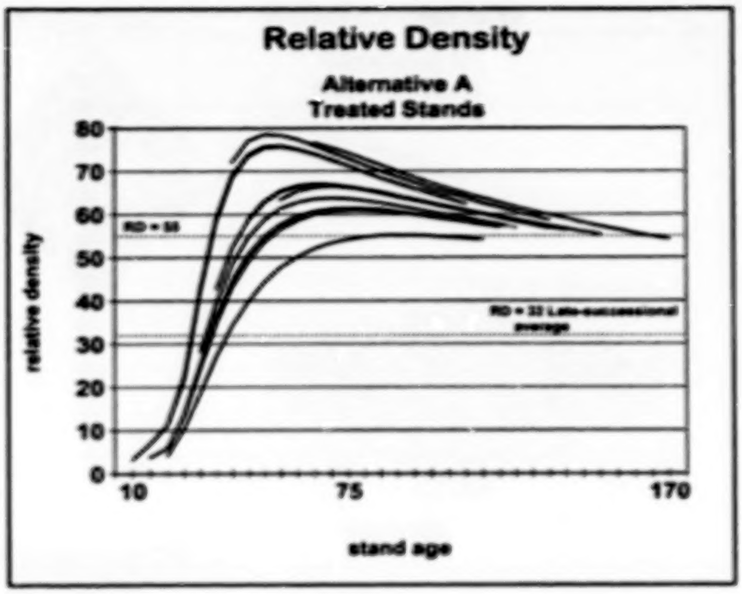


**Figure 16.** *This 45-year-old stand shows the dense, uniform structure that would be typical of stands under Alternative A*

The high density of overstory Douglas-fir would effectively suppress growth of shade-tolerant conifers. The high density would also result in small crowns on the Douglas-fir, as lower branches would die nearly as fast as growth occurs at the tops. Branch size would remain small, as any given branch would have a relatively short lifespan. The slowing of tree diameter growth rates would result in tall trees with relatively small diameters, increasing stand susceptibility to windthrow (Wilson and Oliver 2000). These stands would all develop height:diameter ratios greater than 70, which some studies have found to be unstable for Douglas-fir (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 12). Should a severe windstorm occur, uniform stands of this type would likely react more catastrophically than natural stands (USDA and USDI 1997, Appendix A, p. 4; Wilson and Oliver 2000, pp. 917-918).

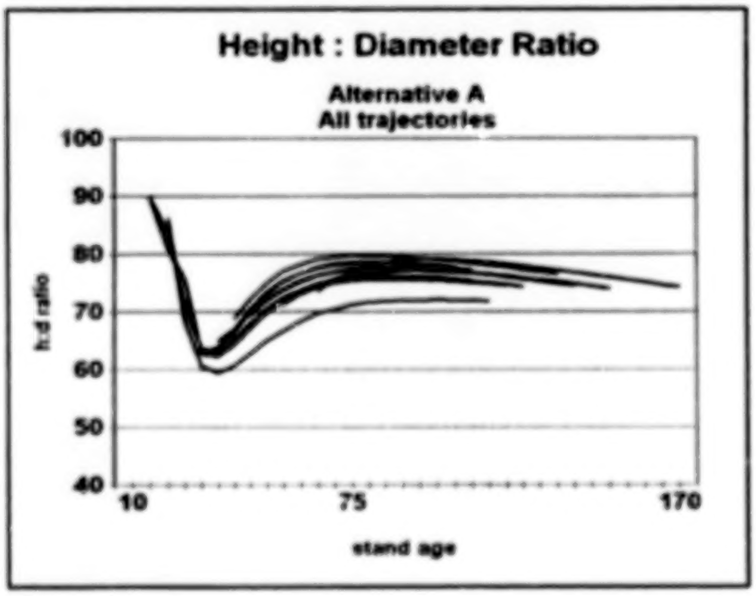


Graph 10



Graph 11.

Following catastrophic disturbance, it is reasonably foreseeable that salvage harvest would occur to reduce risks of fire and insect infestation (USDA and USDI 1994 pp. C-13 - C-16; USDA and USDI 1997, p. 41), and the resultant salvage harvest would effectively start the stand over.



Graph 12

## Key Points

- No young stands would develop late-successional structure within the 100-year analysis period.
- Stands would converge to a high-density, uniform condition.
- Stands may be highly unstable if subjected to natural disturbances.

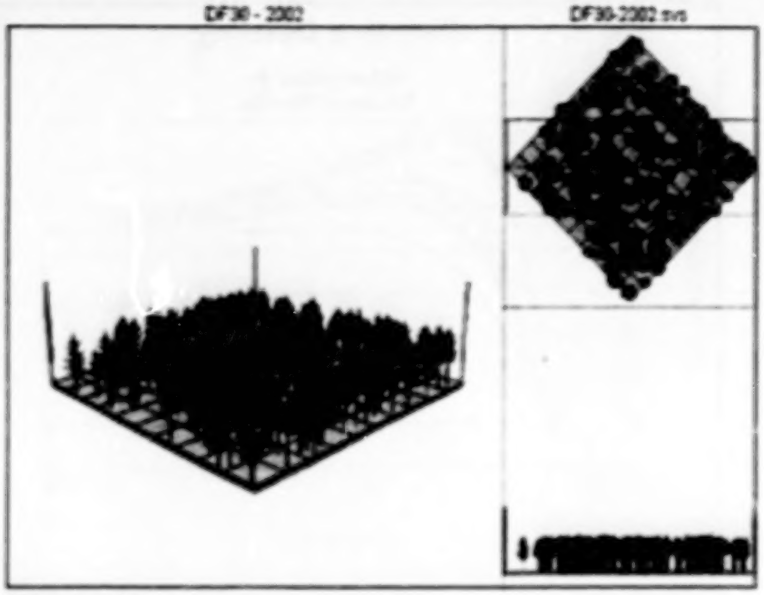


**Figure 17.** *A 30-year-old stand in 2002.*

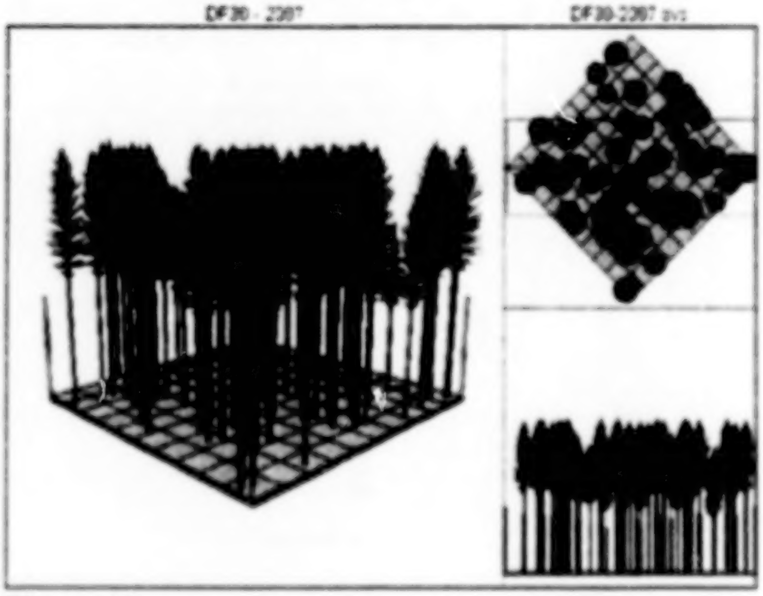


**Figure 18.** *The same stand as in Figure 17 in 2097 under Alternative A.*

## ISSUE 5: *What are the effects of restoration activities on marbled murrelet habitat?*

Under Alternative A, trees would continue growing under dense conditions. In 20 years, 200 acres of stands would develop at least one tree per acre ≥32" dbh, but dense stand conditions would inhibit the growth of the branches and trees would not yet develop at least one branch 5" diameter. In 50 years, 6,500 acres would have at least one tree per acre 32" dbh, but only 500 acres would have trees with at least one branch 5" diameter. All stands would have at least one tree per acre ≥32" " dbh at the end of the 100-year analysis period; 11,850 acres (86%) would also have at least one branch 5" diameter on at least one tree per acre and therefore be considered suitable marbled murrelet nesting habitat (see Graph 41).

Under Alternative A, no stands currently ≤80 years old would achieve target habitat conditions within the 100-year analysis period.

### KEY POINTS

- High stand density would slow the development of suitable nesting habitat.
- No young stands would achieve target habitat conditions within 100 years.

## ISSUE 6: *What are the effects of restoration activities on northern spotted owl habitat?*

Because no federal actions would be taken, Alternative A would not affect existing spotted owl critical habitat. However, the portions of critical habitat that are currently ≤80 years old would not become suitable habitat during the 100-year analysis period.

Currently, 3,728 acres (27%) of stands ≤80 years old provide dispersal habitat. Under Alternative A, all stands would meet the criteria for dispersal habitat in 35 years (see Graph 39).

No stands currently 80 years old would become suitable habitat within the 100-year analysis period. The high density of the stands would prevent the development of a second canopy layer, and therefore the stands would not develop adequate foraging habitat for owls.

No stands currently 80 years old would achieve target habitat conditions within the 100-year analysis period.

### KEY POINTS

- All young stands would develop into dispersal habitat within 35 years.
- No young stands would develop into suitable habitat within 100 years.
- No young stands would achieve target habitat conditions within 100 years.

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**Figure 19.** *Many streams would remain deficient in large woody debris under Alternative A.*

## ISSUE 7: *What are the effects of restoration activities on coho salmon habitat?*

Under Alternative A, BLM would take no actions to increase stream structure, replace or remove barrier culverts, or restore riparian areas for the benefit of coho salmon and other aquatic resources. Roads that degrade water quality and introduce unwanted sediments into streams would not be decommissioned.

**In-stream structure:** Many streams would remain deficient in large woody debris (see Figure 19). Improvement in degraded fish habitat would occur only when riparian stands grow large conifer trees, and those large trees die and fall into the stream. Long-term stability of in-stream large woody debris would improve water quality by reducing erosional stream velocitias, trapping sediments and replenishing groundwater reservoirs that are vital for water storage, water purification, and temperature regulation.

**Riparian stands:** In approximately 70 years, all riparian areas would develop sufficient densities of trees 24" dbh to provide key pieces of large woody debris. This rate is similar to that under the action alternatives. At the end of the 100-year analysis period, approximately 2,500 acres out of 3,400 acres in riparian areas would develop sufficient densities of trees 32" dbh to provide more stable key pieces of large woody debris. Alternative A is the slowest of all alternatives to develop sufficient density of these larger trees.

**Sedimentation:** Road segments that are currently delivering fine sediment to streams would remain in their current condition. These road segments would cause chronic sediment production of approximately 108.0 cubic yards of sediment/year if they continue to be used, and sediment inputs to streams could exceed 10% of background stream turbidity levels.

Many culverts at risk of failure would not be identified and replaced in the absence of road decommissioning. Sedimentation from approximately 30 "total or partial" barrier culverts on BLM-controlled roads would continue and cumulatively may exceed 10% of background stream turbidity levels. The 73 "high-risk"culverts identified in the 2002 road inventory would continue to pose a high risk for road failure. Road-related landslides could escalate because of a lack of road maintenance and culvert replacement. Sediment delivery from landslides would produce larger quantities of sediment than the chronic production from low-use forest roads and would exceed 10% of background stream turbidity levels.

There would be no sedimentation directly caused by restoration actions, such as culvert replacement, road decommissioning, and in-stream structures.

**Barriers:** Under Alternative A, barrier culverts would continue to prevent access to otherwise suitable habitat for coho salmon and other species (see Figure 20).

**Figure 20.** *Under Alternative A, barrier culverts would continue to block access to potential fish habitat.*

## KEY POINTS

- No stable in-stream structure would be created.
- 72% of young riparian forests would develop sufficient density of very large ( 32" dbh) conifers in 100 years.
- Chronic road-related sedimentation would continue at 108.0 cubic yards/year.
- Barrier culverts would continue to block fish habitat.

## ISSUE 8: *How would restoration activities affect the presence and spread of noxious weeds?*

Alternative A would involve no disturbance to soils and existing vegetation from restoration activities and no new road construction. Therefore, there would be little potential for the introduction, establishment, and spread of noxious weeds. The dense stands retained under Alternative A would reduce the light reaching the forest floor, limiting the growth of existing noxious weeds. However, existing seed banks of some noxious weeds, such as Scotch broom, would persist in the soil for decades.

Existing primary roads, especially heavily traveled routes, would continue to be maintained, and therefore continue to provide pathways for the spread of noxious weeds. As a result of limited road maintenance and road use, existing secondary roads would gradually become more shaded as adjacent trees encroach the roadway. This would reduce noxious weed infestations and reduce the potential for roads to act as pathways for the spread of weeds.

As in all alternatives, continued implementation of an integrated noxious weed control program, coupled with continued monitoring and adaptive management, would contribute to a further reduction in noxious weed infestations in the planning area.

**KEY POINTS**

- There would be no additional noxious weed establishment.
- Tree growth would reduce existing noxious weed infestations.

### ISSUE 9: *What would be the economic effects of restoration activities?*

**KEY POINTS**

- There would be no economic benefits derived as a result of restoration.

### ISSUE 10: *What are the costs of restoration?*

**KEY POINTS**

- There would be no costs incurred as a result of restoration.

# ALTERNATIVE B

## PLANTATION AND ROAD MANAGEMENT WITH NO TIMBER HARVEST

Alternative B is designed to accomplish restoration without timber removal. It would thin Douglas-fir plantations, but would leave untreated all unmanaged stands and stands >50 years old. No trees would be intentionally felled or pulled into streams, and no in-stream structures would be constructed. All roads would be decommissioned where legally possible. No new roads would be constructed.

### ISSUE 1: *How would road decommissioning and road management actions alter public access to BLM-managed lands?*

Under Alternative B, approximately 79 miles of road would be decommissioned (47% of the total 169 miles of road on BLM-managed land in the planning area), which would reduce road density from the current density of 4.4 miles of road per square mile to approximately 2.3 miles of road per square mile (see Figure 21). An additional 12 miles of road are "passively" decommissioning (See Chapter 3). Roads that would be decommissioned under this alternative are shown on Map 2.

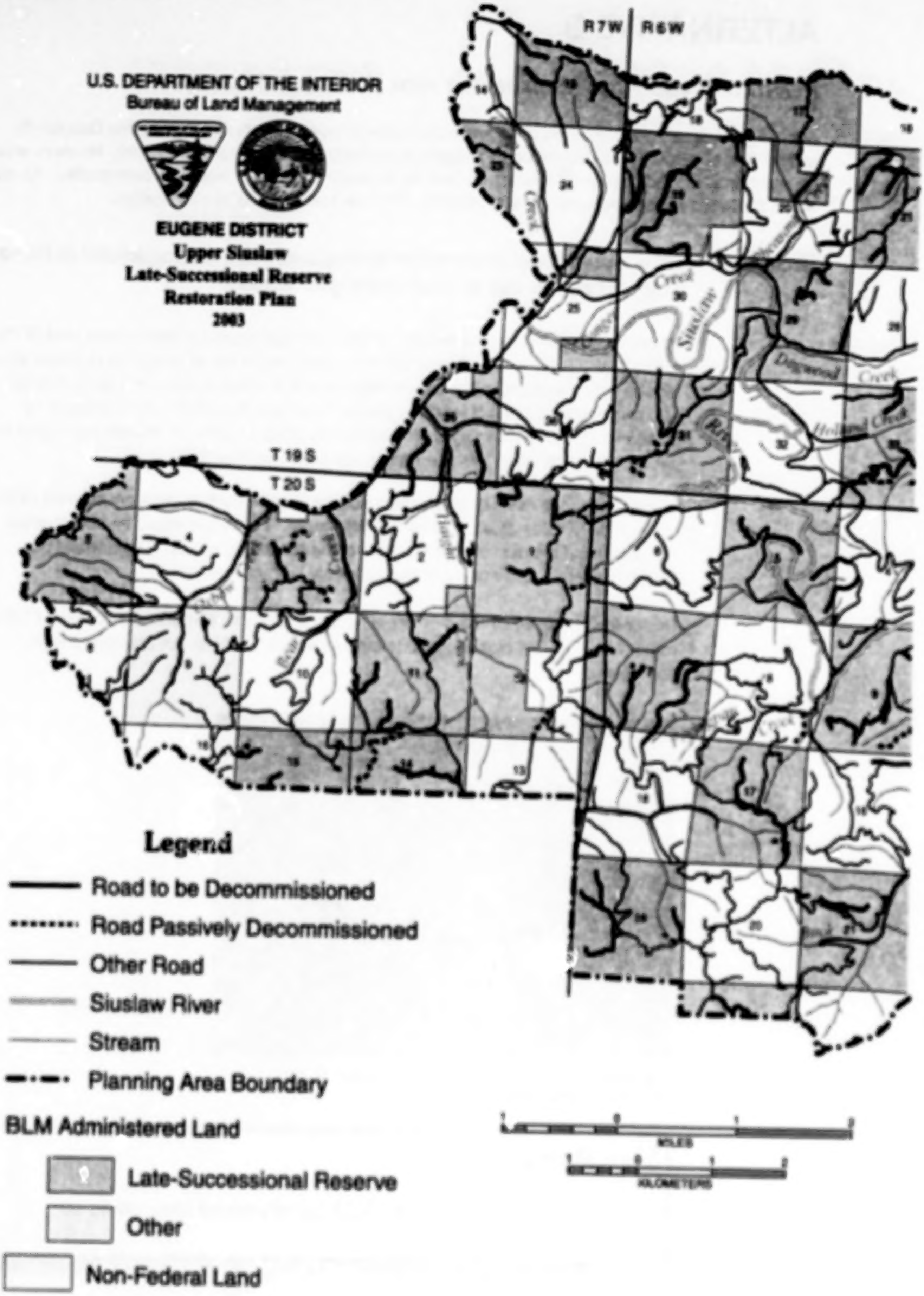
Approximately 25 miles of legal public access roads would be decommissioned (33% of the total 75 miles of legal public access roads). The public would be able to enter the public land in question, but that part of the road lying on public land would be decommissioned and would not be accessible by motor vehicle.

Under Alternative B, 54 miles of "other" roads would also be decommissioned. ("Other" roads would require crossing private land for which BLM has not obtained a legal easement).

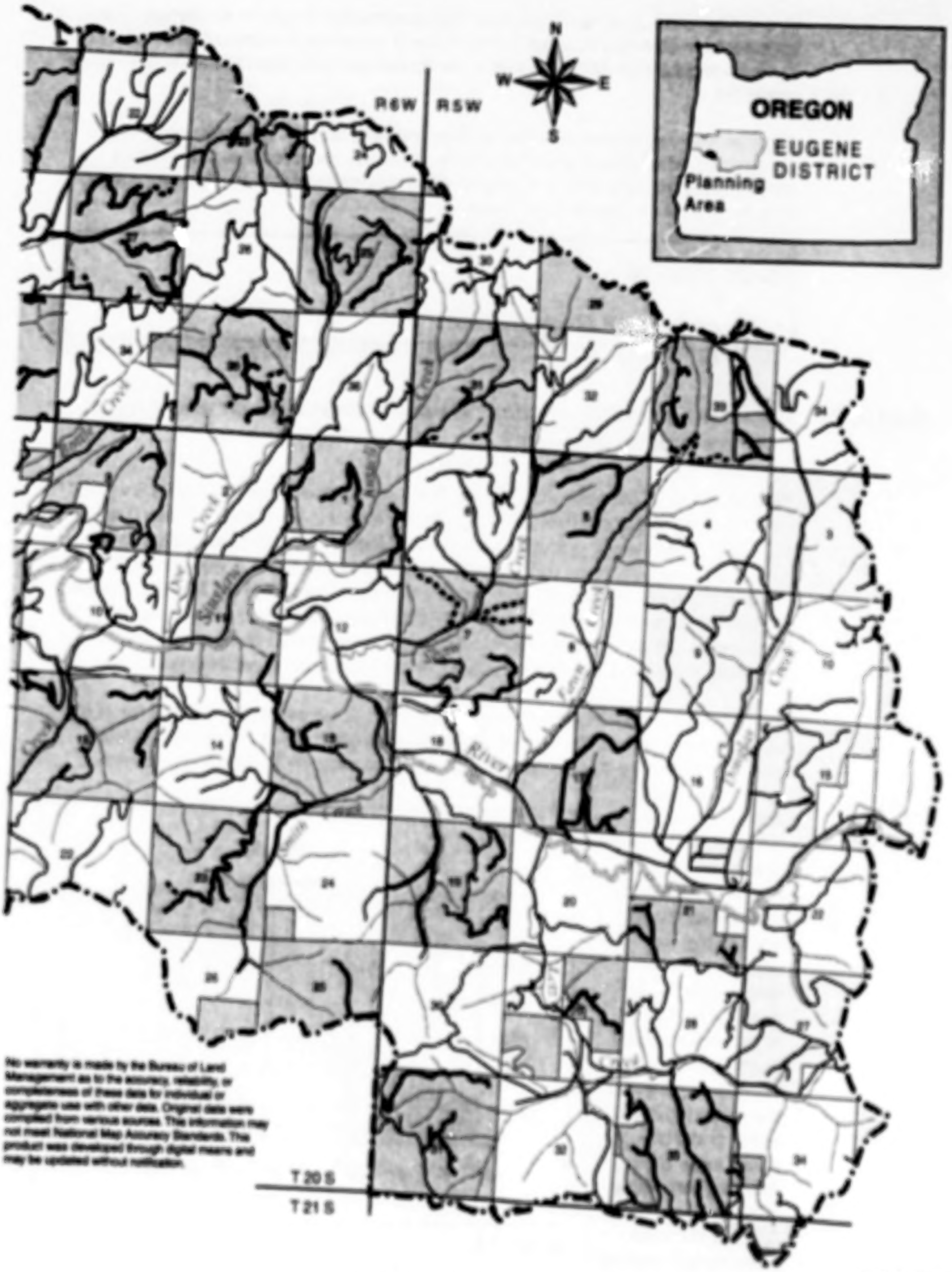
**Figure 21.** *Alternative B would decommission 79 miles of road, more than any other alternative.*

## KEY POINTS

- 79 miles (47%) of road on BLM-administered land would be decommissioned.


U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management
EUGENE DISTRICT
Upper Siuslaw
Late-Successional Reserve
Restoration Plan
2003
R7W
R6W
T 19 S
T 20 S
Siuslaw
River
Dogwood Creek
Halland Creek
Haight
Bear Creek
Creek
Legend
Road to be Decommissioned
Road Passively Decommissioned
Other Road
Siuslaw River
Stream
Planning Area Boundary
BLM Administered Land
Late-Successional Reserve
Other
Non-Federal Land
MILES
KILOMETERS

## **Map 2:** Alternative B - Road Decommissioning



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## ISSUE 2: *How much new road construction would be needed to implement restoration actions?*

Under Alternative B, no new roads would be constructed to support restoration. The full extent of restoration activities in Alternative B would occur in areas that can be treated without constructing new roads. Areas farthest from access roads would remain untreated.

Because 79 miles of road would be decommissioned, and no new roads would be constructed, Alternative B would result in a cumulative reduction in roads and road density in the planning area. The ratio of roads decommissioned : roads constructed (79: 0) is the highest among the alternatives.

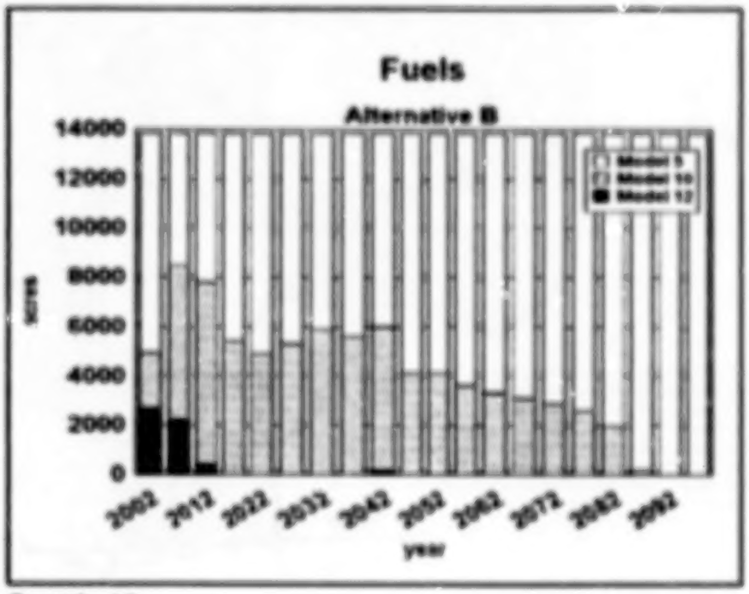
### KEY POINTS

- No roads would be constructed.

## ISSUE 3: *What level of risk to existing late-successional forest would result from restoration activities?*

**Fire:** Because all cut trees would be left in the stands, thinning in Alternative B would immediately create a substantial acreage (2,700 acres) in Fuel Model 12 (see Graph 13). These acres would quickly move into Fuel Models 5 and 10 over a 15-year span as the slash decomposes. Thinning would also reduce the acres in Fuel Model 10 and dramatically shorten the time before these acres move back into Fuel Model 5. Thinning presents a trade-off of a short duration of Fuel Model 12 replacing a long duration in Model 10. Mitigation measures incorporated into the design of Alternative B (see Appendix A) would be effective in reducing the fire risk to an acceptable level.

**Bark Beetles:** At the individual stand scale, there would be some increased risk of bark beetle damage under Alternative B, because large quantities of coarse woody debris would be created by stand management. On approximately 11,300 acres of stands currently 80 years old, the effects of Alternative B on bark beetles would be similar to Alternative A, because stands would either remain untreated, or the residual live trees would be unlikely to experience mortality from bark beetle infestation. However, the remaining 2,500 acres of stands would experience tree mortality, with a total of approximately 5,000-9,900 trees killed by bark beetles.



Graph 13.

This relatively low intensity of mortality (approximately 2-4 TPA) would have little effect on stand structure , but would contribute to snag and coarse woody debris levels. Some additional bark beetle mortality would occur following future coarse woody debris creation that would occur in 10 to 20-year intervals under Alternative B, but such mortality would likely be minor (approximately 4 TPA) because of the moderate quantities of coarse woody debris created and the small number of acres over which debris would be created in any one year. Furthermore, this effect may be moderated by adaptive management in future coarse woody debris creation efforts: tree mortality caused by bark beetles following one interval of coarse woody debris creation may obviate the need for the next interval of coarse woody debris creation. If a natural disturbance, such as a severe windstorm, were to occur, bark beetles would likely cause additional tree mortality.

At the landscape scale, bark beetle populations would be greater than under Alternative A. There would be an increased risk of bark beetle attack on large trees in late-successional stands near thinned, young stands. However, tree mortality in late-successional stands would likely be patchy and sporadic, rather than widespread, and would be unlikely to lead to habitat degradation. If extensive natural disturbances were to occur within the planning area, especially in older stands, some of the remaining large trees within those stands would likely be killed by bark beetles. In such a case, restoration treatments in Alternative B could have a cumulative effect of increasing tree mortality from bark beetles. However, mitigation measures, such as altering the timing and season of tree felling, or deployment of Douglas-fir beetle anti-aggregation pheromone (Schmitz and Gibson 1996; Oregon Department of Forestry 1999), would likely be effective at averting additional tree mortality.

## KEY POINTS

- Thinned stands would move into a low-risk fuel model, resulting in an overall low risk of severe fire.
- Bark beetles would likely cause some individual tree mortality, but would not pose a high risk to existing late-successional forests.

## ISSUE 4: *How would thinning affect development of late-successional forest structural characteristics?*

Under Alternative B, approximately 6,400 acres of the 13,800 acres of stands currently 80 years old would receive no treatment and would continue on their existing developmental pathway (see Graph 14). These untreated stands would develop as described under Alternative A.

Within the 100-year analysis period, 2,300 acres of the stands currently 80 years old would develop late-successional structure.

Because Alternative B would not remove any cut trees, thinning prescriptions would be limited to cutting the smaller trees to mitigate fuel loadings and bark beetle impacts. This would temporarily reduce the range of tree diameters. Individual tree growth rates and stand mean diameter would increase. Subsequent coarse woody debris creation may lower stand mean diameter slightly.

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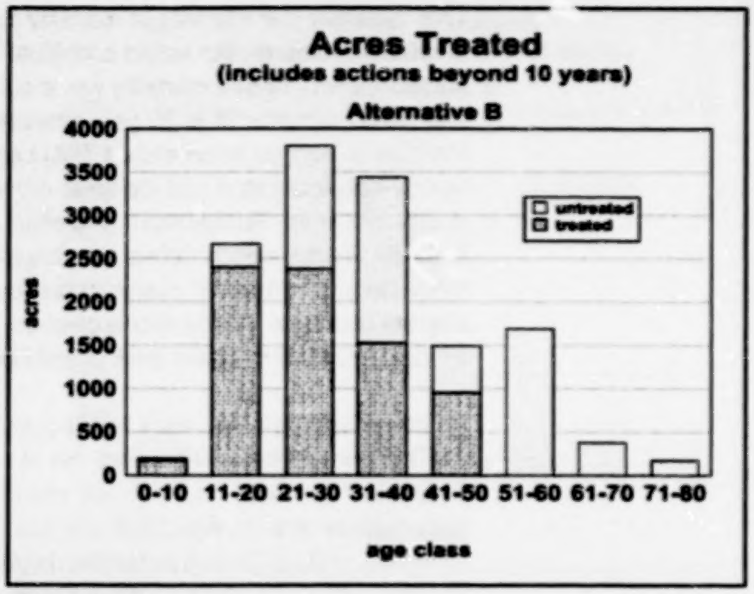
Development of understories of shade-tolerant conifers would be inhibited. In stands <30 years old, the extensive ground covered by cut trees would limit the natural establishment or planting of shade-tolerant conifer seedlings (see Figure 22). In stands 30 years old, the overstory would be too dense, even after thinning, to allow growth of shade-tolerant conifers in the understory. In all of the prescriptions, subsequent treatments would likely cut (or create snags of) 10 TPA at 10 to 20-year intervals beyond the 10-year span of the proposed plan. Shade-tolerant conifers could be planted at the time of future coarse woody debris/snag treatments and would be more likely to establish and grow than those planted after the initial thinning.



**Graph 14.**

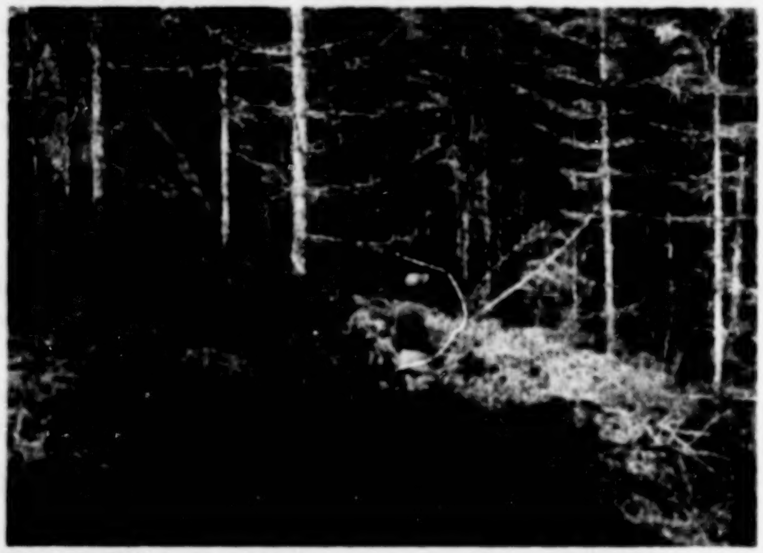
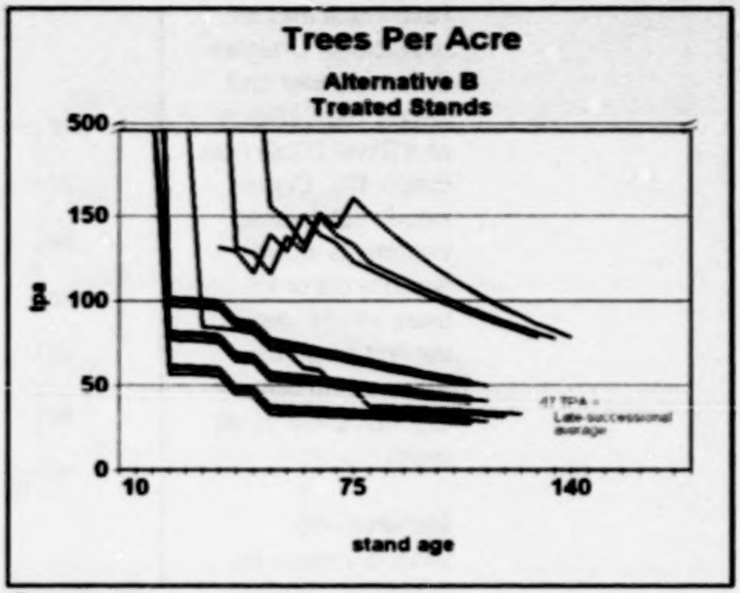
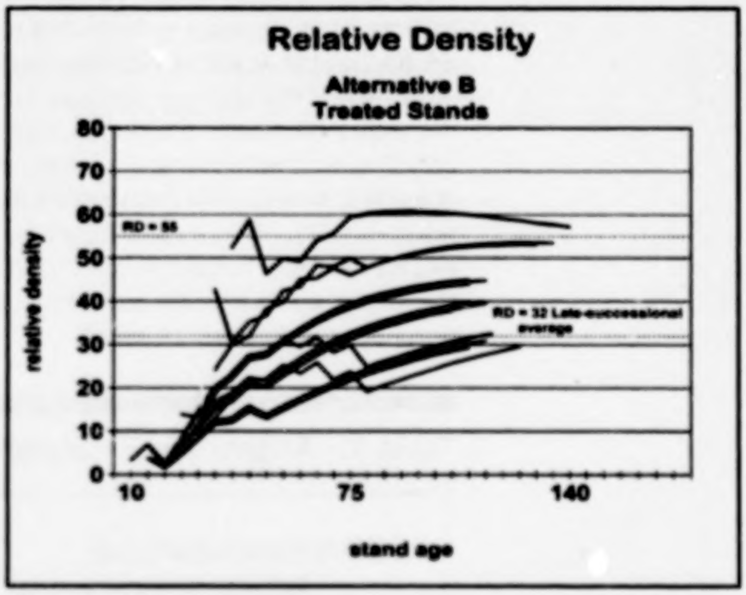


**Figure 22.** *Thinning without timber removal in young stands would result in extensive ground coverage by cut trees, which would limit establishment of conifer seedlings.*

Stands <21 years old would be thinned to three levels of residual density: 40-60, 60-80, and 80-110 Douglas-fir TPA. Cut trees would typically be 8"-10" dbh. At the end of the 100-year analysis period, these three thinning prescriptions would place these stands on three distinct pathways, with 30, 40, and 50 TPA, and relative densities of approximately 30, 40, and 45 (see Graphs 15 and 16). Natural establishment of Douglas-fir and shade-tolerant conifer seedlings would occur after thinning and would result in some rebound of stand density. However, natural establishment of seedlings would be limited in some areas by the extensive ground covered by cut trees left after thinning. The cut trees would also generally preclude planting. These stands would develop height:diameter ratios between 55 and 65, which would be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 17). The first coarse woody debris/snag treatments, which would occur in approximately 20-25 years, would typically cut or kill trees 16" -22" dbh.



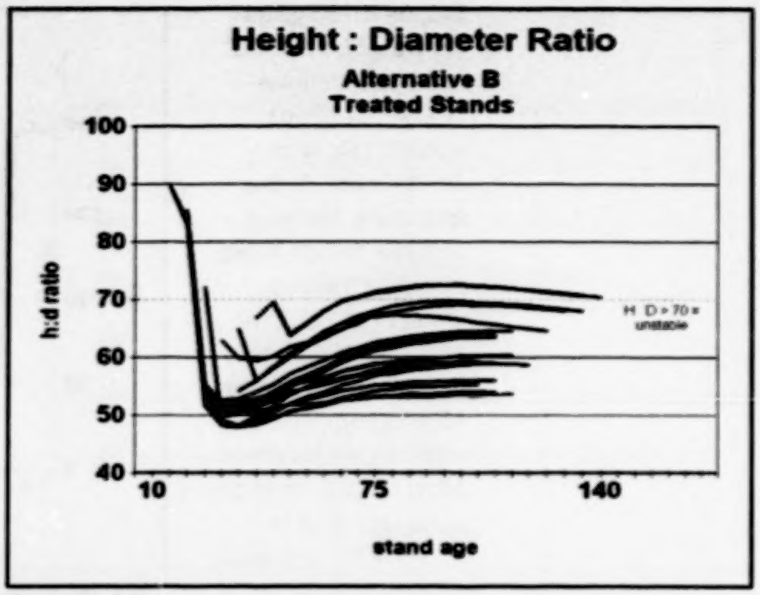
**Graph 15.**



**Graph 16.**

Stands 21-30 years old would be thinned to 50-100 Douglas-fir TPA. Cut trees would typically be 10"-14" dbh. At the end of the 100-year analysis period, these treatments would result in 30 -35 TPA and a relative density of 30-35 (see Graphs 15 and 16). This relative density would allow trees to maintain crown ratios at or above 50%, and would provide sufficient light for growth of naturally-seeded shade-tolerant conifers. However, the natural establishment of shade-tolerant conifers would be delayed in some areas by the extensive ground covered by cut trees. For example, Figures 23 and 24 illustrate the development of the 30-year-old stand, showing the thinning treatment in 2002, and the moderately open overstory and moderate development of the shade-tolerant understory in at the end of the 100-year analysis period. These stands would develop height:diameter ratios between 60 and 65, which would generally be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 17). Coarse woody debris/snag treatments would typically cut or kill trees 16"-24" dbh in the first treatment, which would occur in approximately 20-25 years.

Stands 31-40 years old would be thinned to 100-150 Douglas-fir TPA. Cut trees would typically be 10" -16" dbh. At the end of the 100-year analysis period, these treatments would result in about 75 TPA and would maintain high relative densities – between 50 and 55, just below the point at which density-dependent mortality would begin (see Graphs 15 and 16). At the end of the 100-year analysis period, these stands would be essentially similar to the unthinned stands. Crown ratios would remain near 50%, shade-tolerant conifer growth would be suppressed, and understory trees would remain small and considerably below the overstory canopy. The natural establishment of shade-tolerant conifers would be delayed in some areas by the extensive ground covered by cut trees. These stands would develop height:diameter ratios around 70, which studies have found may be unstable for Douglas-fir (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 17). Coarse woody debris/snag treatments would typically cut or kill trees 18"-24" dbh in the first treatment, which would occur in approximately 15-20 years.



**Graph 17.**

Stands 41-50 years old would be thinned to 100-200 Douglas-fir TPA. Cut trees would typically be 12"-16" dbh. At the end of the 100-year analysis period, these treatments would result in 75-85 TPA and would maintain high relative densities – about 55, the point at which density-dependent mortality would begin (see Graphs 15 and 16). At the end of the 100-year analysis period, these stands would be essentially similar to the unthinned stands. Crown ratios would decrease to less than 50%, shade-tolerant conifer growth would be suppressed, and understory trees would remain small and considerably below the overstory canopy. These stands would develop height:diameter ratios near 70, which studies have found may be unstable for Douglas-fir (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 17). Coarse woody debris/snag treatments would typically cut or kill trees 20"-24" dbh in the first treatment, which would occur in approximately 15 years.

## Table 3. - Alternative B - Stand Treatment and Results Summary

| STAND TREATMENT AND RESULTS | | STAND AGE | | | |
|---|---|---|---|---|---|
| | | <21 | 21-30 | 31-40 | 41-50 |
| **Thinning prescription (during 10-year span of proposed plan)** | **TPA*** | 40-60<br>60-80<br>80-110 | 50 | 100-150 | 100-200 |
| **Resulting Stand Characteristics (end of 100-year analysis period)** | **TPA** | 30<br>40<br>50 | 30-35 | 75 | 75-85 |
| | **RD** | 30<br>40<br>50 | 30-35 | 50-55 | 55 |
| | **H:D** | 55-65 | 60-65 | 70 | 70 |

*Uplands and 100-foot riparian areas would receive same treatments

In summary, extensive thinning in stands ≤30 years old would effectively speed the development of large Douglas-fir trees, and would be moderately effective at establishing some shade-tolerant conifers. However, thinning would not effectively spread the range of tree diameters because relatively few new trees would be able to establish following thinning in the absence of some removal of cut trees. Thinning would create stands that are likely to be stable over the 100-year analysis period (see Table 3).

Thinning would also be extensive in stands 31-50 years old, but the mitigations necessary to avoid unacceptable fuel loadings and bark beetle impacts would severely limit the effectiveness of thinning. Thinning in these stands would do little to speed the development of late-successional forest structure compared to unthinned stands, and would create stands that would be at the upper limit of stand stability (see Table 3). Stands >50 years old would not be thinned and would develop as described under Alternative A.

## KEY POINTS

- 7,400 acres (54%) of stands currently ≤80 years old would be treated over 10 years.
- 2,300 acres would develop late-successional structure.
- Thinning would speed development of late-successional structure in stands ≤30 years old.
- Thining in stands 31-50 years old would be ineffective, and stands may become unstable.

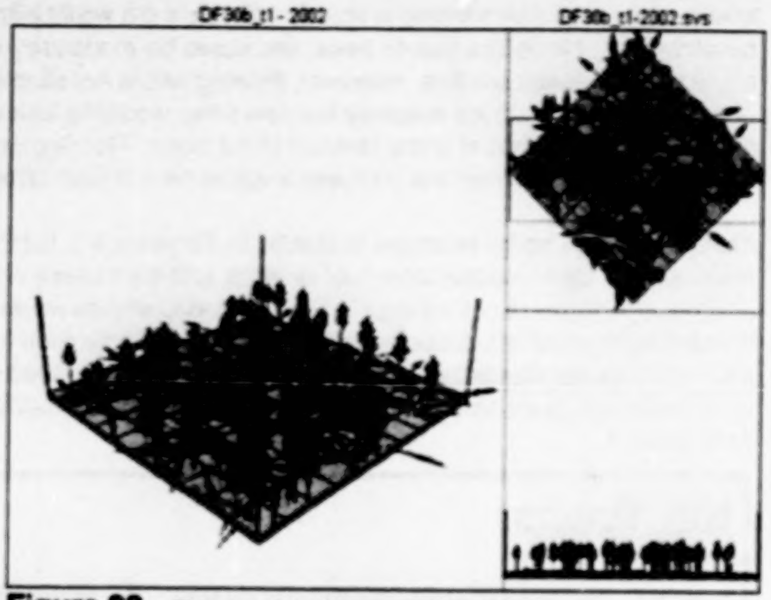


**Figure 23.** *Thinning of the 30-year-old Type Stand*

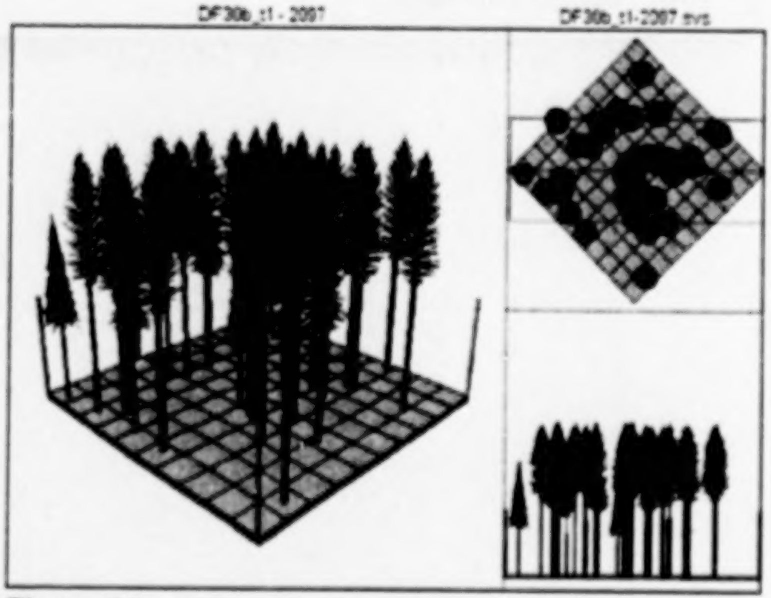


**Figure 24.** *Development of the 30-year-old Type Stand*

## ISSUE 5: *What are the effects of restoration activities on marbled murrelet habitat?*

Alternative B would not thin stands >50 years old and would thereby avoid adverse effects to marbled murrelets.

Under Alternative B, stands would develop trees 32" dbh at approximately the same rate as in Alternative A. However, Alternative B would speed the development of large branches. In 50 years, 2,000 acres would have at least one tree per acre with at least one branch 5" diameter, nearly four times the amount in Alternative A. In Alternative B, nearly all of the stands currently 80 years old would be able to grow at least one tree per acre with at least one branch 5" diameter within the 100-year analysis period (13,600 acres or 98%). The most heavily thinned stands would have trees with even larger branches (up to 7-1/2" diameter at the end of the 100-year analysis period).

Under Alternative B, no stands currently 80 years old would achieve target habitat conditions within the 100-year analysis period, because none of the stands would develop a wide enough range of tree diameters, and few stands would support sufficient shade-tolerant conifers.

### KEY POINTS

- All stands would have trees 32" dbh, and almost all would develop branches 5" and larger (up to 7-1/2") within 100 years.
- No young stands would achieve target habitat conditions within 100 years.

## ISSUE 6: *What are the effects of restoration activities on northern spotted owl habitat?*

In Alternative B, stands >50 years old would not be thinned, which would generally maintain dispersal habitat and avoid impacts to foraging habitat. Alternative B would periodically create small quantities of snags and coarse woody debris after thinning, which would continue to improve habitat conditions for spotted owl prey species and thereby improve foraging habitat quality.

Dispersal habitat development under Alternative B would be similar to Alternatives A, C, and F. All stands would become dispersal habitat within 80 years; most of the stands (13,000 acres or 94%) would become dispersal habitat within 40 years. The amount of dispersal habitat would periodically drop slightly relative to Alternative A as a result of coarse woody debris creation in future decades. However, at the time of these periodic drops in dispersal habitat, 85% of currently young stands will have already developed into dispersal habitat.

Under Alternative B, 3,200 acres (23% of stands currently 80 years old) would become suitable habitat by the end of the 100-year analysis period. A smaller acreage – 2,300 acres (17%) – would achieve target habitat conditions nesting habitat by the end of the 100-year analysis period.

**KEY POINTS**

- All young stands would develop into dispersal habitat similar to Alternative A, except for some slight periodic reductions resulting from coarse woody debris creation.
- 3,200 acres would develop into suitable habitat within 100 years.
- 2,300 acres would achieve target habitat conditions within 100 years.

## ISSUE 7: *What are the effects of restoration activities on coho salmon habitat?*

**In-stream structure:** Alternative B would not intentionally create any in-stream woody debris, but the thinning actions in the riparian area would incidentally fall substantial quantities of logs into streams. Alternative B would thin 1,800 acres (53%) of riparian areas (105.7 miles of 1st-2nd-order streams; 23.6 miles of 3rd-5th-order streams). Thinning would produce relatively small logs (8"-12" diameter, with some logs 12"-20" diameter). All cut trees would be retained in the riparian area, producing large quantities of logs (generally 80-200 TPA). Approximately 160 trees per stream mile (approximately 25 TPA) would be felled directly into streams, meeting the ODFW riparian habitat benchmark for total pieces of woody debris, but completely lacking in key pieces.

On 1st and 2nd-order streams, this woody debris would be generally stable and would result in increased stream complexity of 105.7 miles of 1st and 2nd order streams (although this debris would likely not be stable in the event of a flood larger than the 50-year flood).

These logs would not be stable in 3rd-5th-order streams and would likely be lost from the stream system following a 50-year flood, except on the five stream systems with existing stable structure (see Chapter 3). On all other 3rd-5th-order streams, Alternative B would have long-term effects on stream complexity similar to Alternative A.

It is reasonably foreseeable that, beyond the 10-year span of this plan, 10 TPA would be felled at 10-year intervals in thinned riparian stands, providing logs generally 12"-24" diameter, with some logs >24" diameter in later treatments. However, in the absence of intentional, directional falling to the stream, too few of these trees would likely enter the stream channel to provide stable, in-stream structure in 3rd-5th-order streams.

**Riparian stands:** Alternative B would have effects on the development of riparian trees large enough to provide key pieces of woody debris (24" dbh) similar to all alternatives (See Alternative A, Issue 7). However, it would take considerably longer to develop sufficient density of very large trees that would provide more stable key pieces of woody debris (32" dbh): at the end of the 100-year analysis period, approximately 2,900 acres out of 3,400 riparian acres (84%) would have developed 13 trees per acre 32" dbh. Alternative B would be faster than Alternatives A, C, and F to develop sufficient density of these larger trees, but slower than Alternatives D and E.

**Sedimentation:** Under Alternative B (like all action alternatives), all non-shared, BLM-controlled roads that are capable of delivering fine sediment to streams would be decommissioned. The 2002 road inventory found that approximately 4.9 miles of BLM-controlled roads are capable of delivering fine sediment to streams, and an additional 0.7 miles that are shared roads could be decommissioned with the consent of private owners. After decommissioning, natural drainage would be restored. This decommissioning would reduce chronic, road-related sediment delivery to the streams from 108.0 cubic yards/year to 74.0 cubic yards/year. Although Alternative B would decommission additional roads beyond the roads that are capable of delivering sediments to streams, the additional road decommissioning would have no measurable effect on the amount of sediment reaching streams. During road decommissioning, there would be short-term pulses of sedimentation from activities such as subsoiling and culvert removal.

Under Alternative B (like all action alternatives), all culverts identified in the 2002 road inventory as a high-risk of failure would be replaced or removed. This would eliminate the potential sedimentation from road-related landslides, but would result in temporary pulses of sediment of approximately 7.3 cubic yards/year over 10 years. Additionally, under Alternative B (and all other action alternatives), 10 fish-barrier culverts identified in the 2002 road inventory would be replaced or removed, which would result in temporary pulses of sediment of approximately 1.7 cubic yards/year over 10 years.

Under Alternative B, there would be no new road construction or construction of in-stream structures.

**Barriers:** Alternative B (like all action alternatives) would remove culverts that constitute barriers to the movement of anadromous fish and other aquatic organisms or replace them with passage-friendly culverts, bridges, or crossings. The 2002 road inventory assessed 16 fish-barrier culverts on BLM-controlled roads, of which 10 were recommended for removal or replacement. Removing or replacing these 10 fish-barrier culverts would open 7.0 miles of new habitat available for coho salmon.

## KEY POINTS

- Stable in-stream structure would be created on 105.7 miles of 1st-2nd-order streams, and 0 miles of 3rd-5th-order streams in 10 years.
- 84% of young riparian forests would develop sufficient density of very large (32" dbh) conifers in 100 years.
- Existing road-related sedimentation would be reduced to 74.0 cubic yards/year. Restoration actions would cause a total of 9.0 cubic yards of sediment/year.
- Removal of 10 barrier culverts would open 7.0 miles of new coho salmon habitat.

## ISSUE 8: *How would restoration activities affect the presence and spread of noxious weeds?*

Alternative B would result in some disturbance to both soils and existing vegetation from forest management activities in stands <50 years old, which could potentially result in further establishment and spread of noxious weeds in treated stands within the planning area. However, Alternative B would include no new road construction, which would avoid the creation of new vectors for the spread of noxious weeds

Decommissioning 79 miles of road would substantially reduce the vectors for the introduction, establishment, and spread of noxious weeds within the planning area (see Figure 25). Alternative B would decommission the most roads of all the alternatives, thus contributing to the greatest reduction of potential road vectors for noxious weeds within the planning area.

**Figure 25.** *Extensive road decommissioning in Alternative B would reduce the establishment and spread of noxious weeds.*

Existing primary and secondary roadways remaining open to vehicular traffic, especially heavily traveled routes, would continue to be vectors for the spread of weeds. Infrequently traveled secondary roads would gradually become more shaded over time as native vegetation and overhead shade from adjacent trees encroach existing roadways. This would contribute to a reduction in noxious weeds.

As in all alternatives, continued implementation of an integrated noxious weed control program, coupled with continued monitoring and adaptive management, would contribute to a further reduction in noxious weed infestations in the planning area.

**KEY POINTS**

- Decommissioning 79 miles of road and no new road construction would reduce noxious weed establishment and spread.

## ISSUE 9: *What would be the economic effects of restoration activities?*

Under Alternative B, there would be 8,100 acres of non-commercial silvicultural treatments, which would generate approximately 250 months of contract work over the entire 10-year implementation period (30 months of work for silvicultural treatments for each of the first three years of implementation, 40 months of work for each of the second three years, and 10 months of work for each of the final four years).

Decommissioning 79 miles of road would generate 32 months of contract work.

Replacing 10 culverts would generate 11 months of contract work, the same as in all action alternatives.

Because all silvicultural treatments under Alternative B would be non-commercial, there would be no revenue generated from the sale of forest products. Some post/pole and firewood sales and other special forest product sales would likely occur, but these activities would provide negligible revenue.

**KEY POINTS**

- 293 months of contract work over 10 years.
- No revenue would be generated.

## ISSUE 10: *What are the costs of restoration?*

During the 10-year span of the proposed plan, silvicultural treatments in Alternative B would incur $1.35 million in contract costs and $400,000 in BLM staff costs (8 work months per year, or $40,000 per year).

Decommissioning 79 miles of road would incur $1.2 million in contract costs and $790,000 in BLM staff costs. Replacing culverts would incur $790,000 in contract costs and $370,000 in BLM staff costs, the same as all action alternatives.

**KEY POINTS**

- $3.3 million in contract costs over 10 years.
- $1.6 million in BLM staff costs over 10 years.

# ALTERNATIVE C

## CONTINUE CURRENT MANAGEMENT APPROACH

Alternative C is designed to continue the current pace of restoration, using current silvicultural techniques and stream restoration strategies. Stands would be thinned at ages 41-80 years old. In-stream woody debris structures would be constructed, and some structures would be cabled for stability. Alternative C would decommission eroding roads and roads in late-successional forest and would construct new roads as needed.

### ISSUE 1: *How would road decommissioning and road management actions alter public access to BLM-managed lands?*

Under Alternative C, approximately 24 miles of road would be decommissioned (14% of the total 169 miles on BLM-managed land in the planning area), which would reduce road density from the current density of 4.4 miles of road per square mile to approximately 3.8 miles of road per square mile. An additional 12 miles of road are "passively" decommissioning (See Chapter 3). Roads that would be decommissioned under this alternative are shown on Map 3.

Approximately 5 miles of legal public access roads (7% of the total 75 miles of legal public access) would be decommissioned. Visitors would be able to enter the public land in question, but that part of the road lying on public land would be decommissioned and would not be accessible by motor vehicle.

Under Alternative C, 19 miles of "other" roads would also be decommissioned. ("Other" roads would require crossing private land for which BLM has not obtained a legal easement).

**KEY POINTS**

- 24 miles (14%) of road on BLM-managed land would be decommissioned.

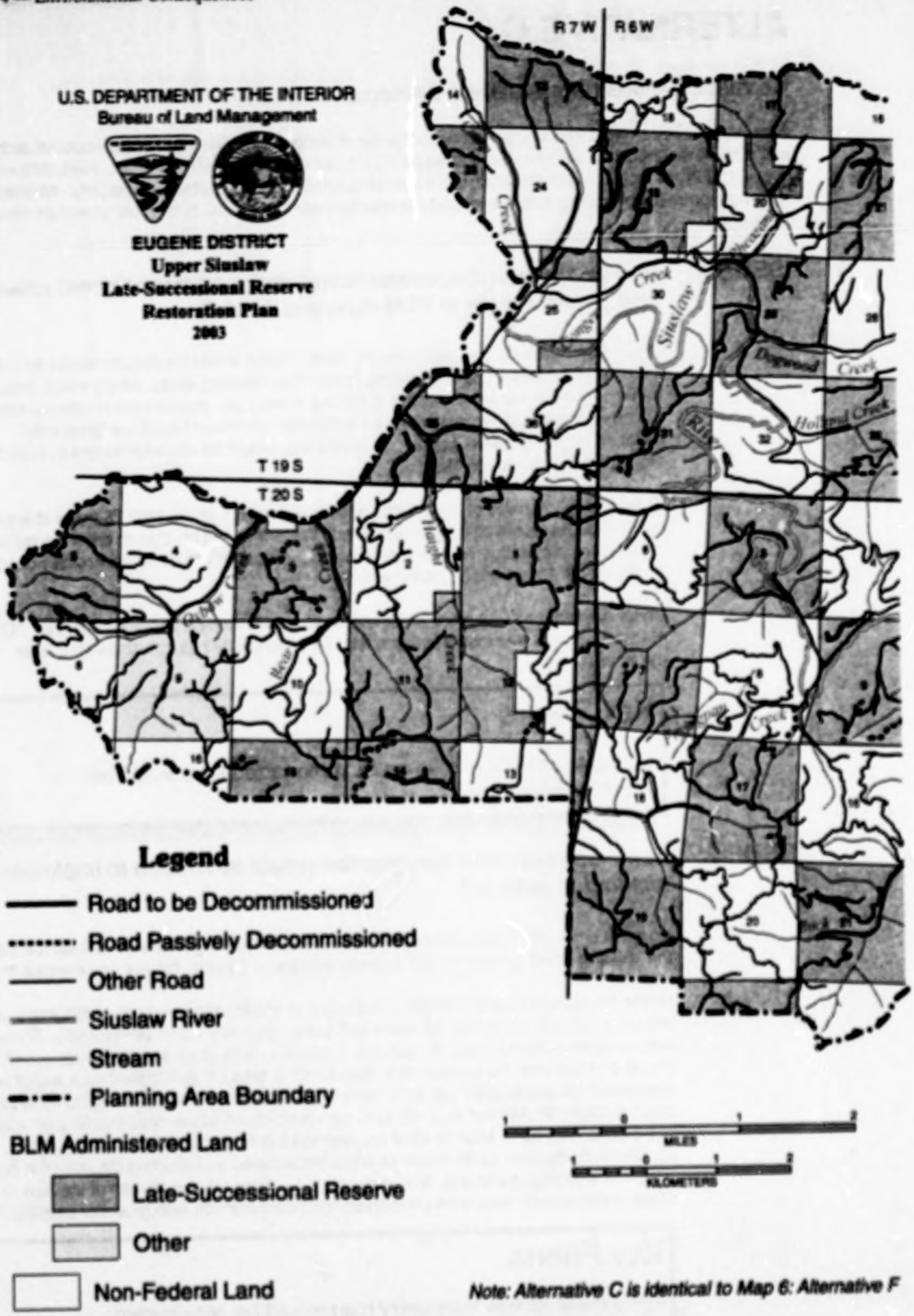
### ISSUE 2: *How much new road construction would be needed to implement restoration actions?*

No road construction would be needed to treat the very young (≤20 year old) stands, because the existing road system would provide adequate access for pre-commercial thinning.

Under Alternative C, approximately 900 acres of stands ranging from 41-80 years old would be thinned in the next 10 years and some cut trees would be removed. This would require suitable road access for yarders, log trucks, and other harvesting equipment. Based on past thinning operations in the planning area, an average of 40.2 feet of new road would be constructed per acre harvested. Therefore, Alternative C would result in approximately 36,180 feet (6.9 miles) of new road construction over the 10-year span of the proposed plan. Most or all of the new road construction would be temporary construction; the new roads would be decommissioned and blocked following the completion of thinning operations. It is possible, but unlikely, that a portion of the new road construction would need to be permanent road construction with gravel or paved surface.

**KEY POINTS**

- 6.9 miles of new temporary road would be constructed.



Note: Alternative C is identical to Map 6: Alternative F

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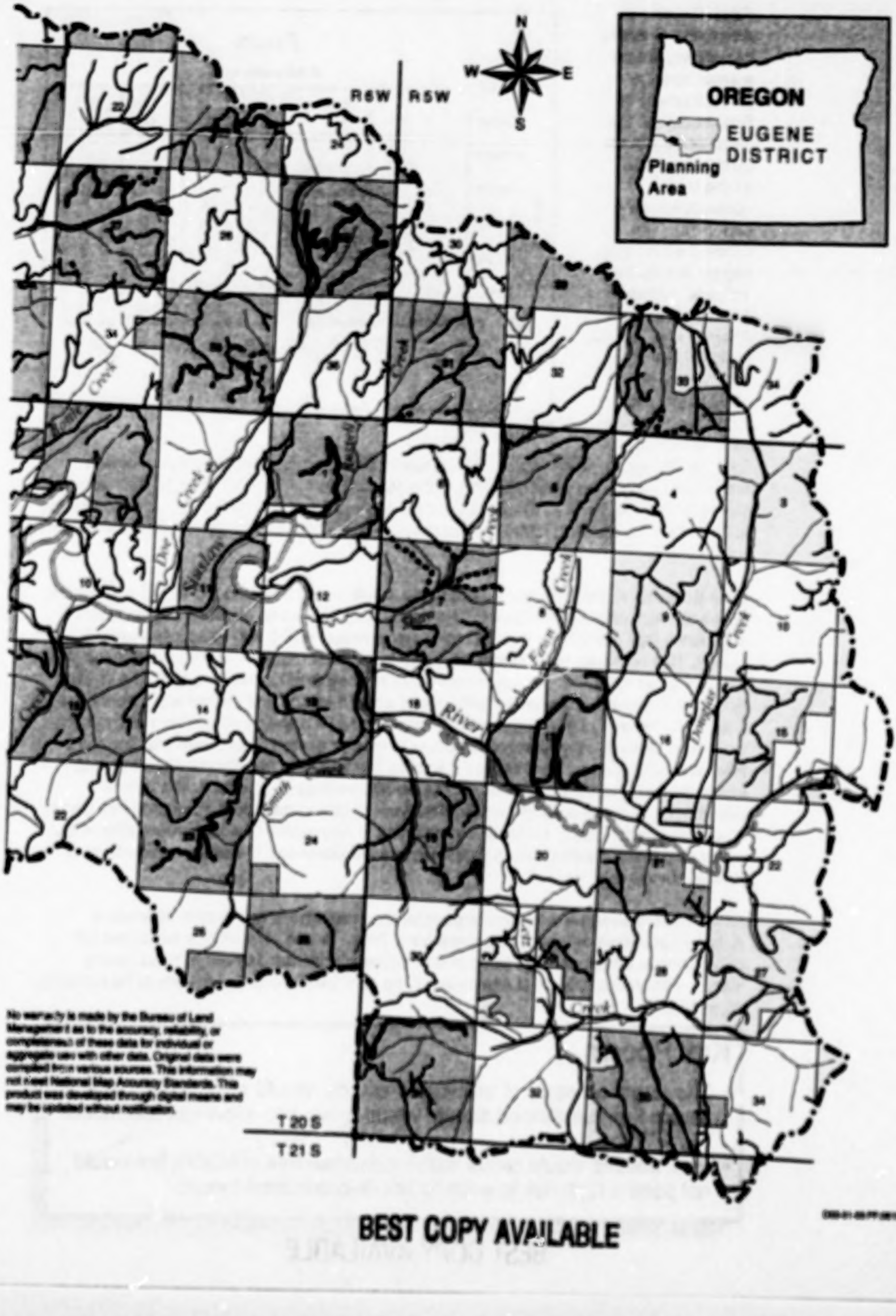
## **Map 3:** Alternative C - Road Decommissioning



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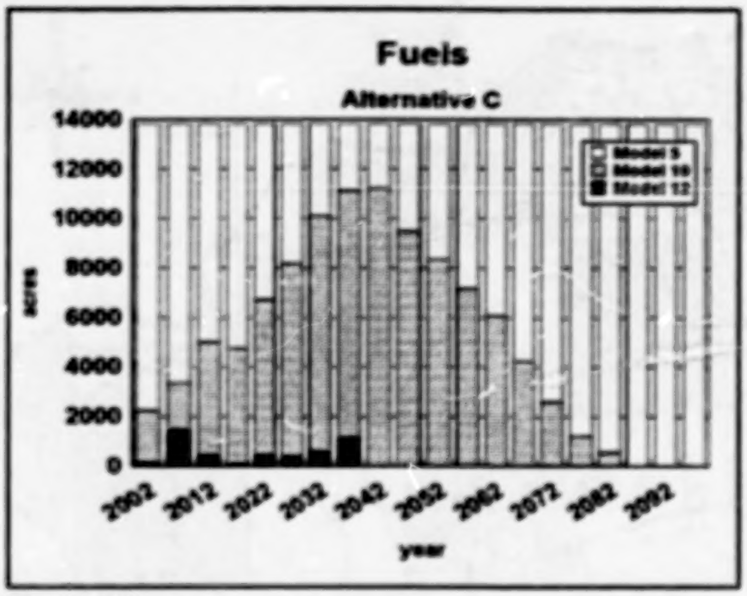
## ISSUE 3: *What level of risk to existing late-successional forest would result from restoration activities?*



Graph 18.

**Fire:** Thinning in Alternative C would periodically create a small acreage (<1,000 acres) in Fuel Model 12, but these acres would quickly decrease as the slash decomposes (see Graph 18). The thinning would only slightly reduce the acreage in Model 10, compared to Alternative A. Similar to Alternative A, the majority of stands currently 80 years old would be in Model 10 for about 40 years, which would present a substantial and long-lasting risk of severe fire. Maintaining such a large portion of the landscape in this fuel model for such a long period of time would pose a high risk of catastrophic fire that would damage existing late-successional forests and retard development of late-successional forest characteristics in young stands.

**Bark Beetles:** At the individual stand scale, there would be some increased risk of bark beetle damage under Alternative C. Approximately 900 acres of young stands would experience tree mortality, with a total of approximately 900-5,400 trees killed by bark beetles. This relatively low intensity of mortality (approximately 1-6 TPA) would have little effect of stand structure, but would contribute to snag and coarse woody debris levels. Some additional bark beetle mortality would occur if snags and coarse woody debris are created at the time of thinning, similar to Alternative F. If snag and coarse woody debris creation is delayed, any additional effect may be moderated by adaptive management: tree mortality cause by bark beetles following thinning may obviate the need for snag and coarse woody debris creation, similar to Alternatives B, D, and E. If a natural disturbance, such as a severe windstorm, were to occur, bark beetles would likely cause additional tree mortality. However, the thinning in Alternative C would create stands that would be relatively stable, which would reduce the likelihood of extensive blowdown in thinned stands (see Issue 4).

At the landscape scale, bark beetle populations would be larger than in Alternative A, but smaller than other action alternatives. There would be a slightly increased risk of bark beetle attack on large trees in late-successional stands near thinned, young stands. Otherwise, effects of Alternative C on bark beetle populations would be similar to Alternative B.

### KEY POINTS

- The large acreage of unthinned stands would pose a high risk of severe fire, but thinned stands would move into a low-risk fuel model.
- Bark beetles would cause some individual tree mortality, but would not pose a high risk to existing late-successional forests.

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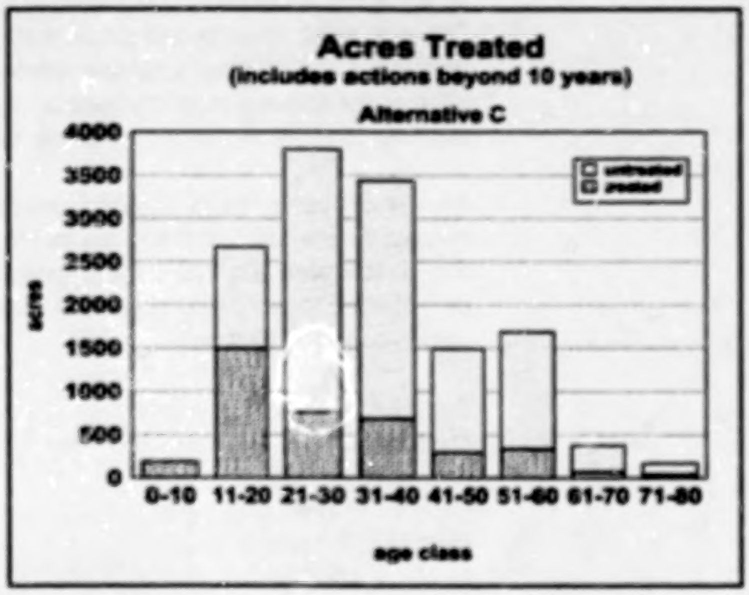
## ISSUE 4: *How would thinning affect development of late-successional forest structural characteristics?*

Under Alternative C, approximately 9,900 acres of the 13,800 acres of stands currently 80 years old would receive no treatment and would continue on their existing developmental pathway (see Graph 19). Alternative C leaves more acres untreated than any other action alternative. These untreated stands would develop as described under Alternative A.



**Graph 19.**

Alternative C would thin with timber harvest approximately 900 acres during the 10-year span of the proposed plan. It is reasonably foreseeable that under the management approach of Alternative C, an additional 3,000 would be thinned beyond the 10-year span of the proposed plan (i.e., when stands that are currently ≤30 years old become 41-80 years old).

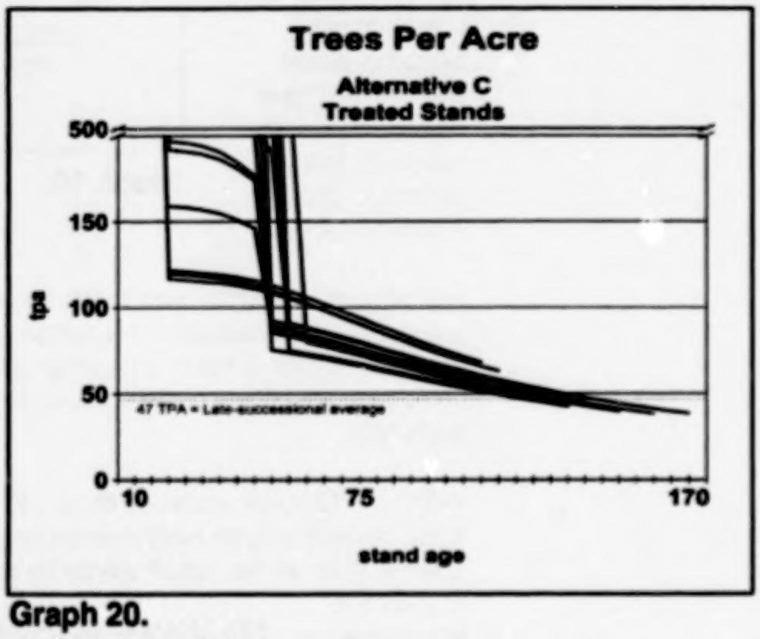
Within the 100-year analysis period, 100 acres of the stands currently 80 years old would develop late-successional characteristics. Alternative C would be slightly more effective than the No Action alternative at speeding the development of large Douglas-fir trees and shade-tolerant conifers, but would be less effective than all other action alternatives. Alternative C would not be effective at spreading the range of tree diameters.

**Figure 26.**. *Thinning prescriptions in Alternative C would maintain even, moderate-density overstories.*

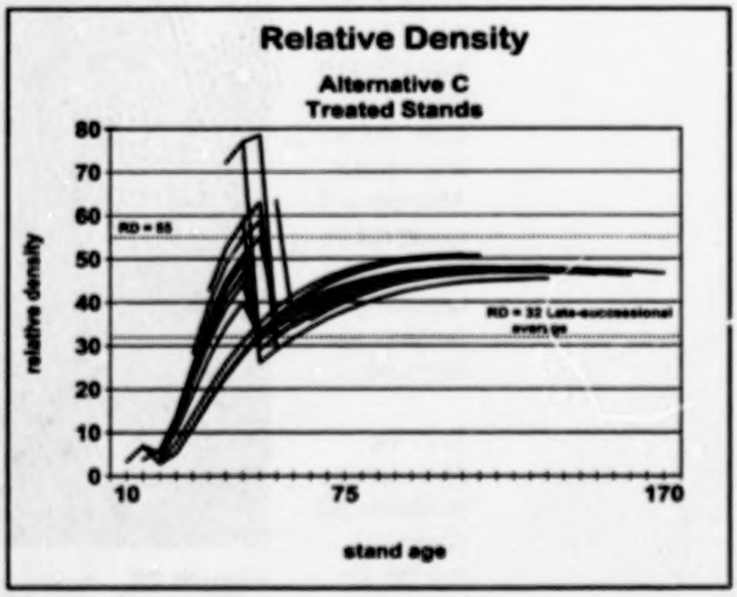
Thinning prescriptions in Alternative C would thin stands from below, i.e., cut the smaller trees (see Figure 26). However, the thinning prescriptions would not be as limited as in Alternative B (see Table 4), because removal of some cut trees in Alternative C would mitigate fuel loadings and bark beetle impacts. Thinning would increase individual tree growth rates and thereby increase stand mean tree diameters. These thinning prescriptions would temporarily reduce the range of tree diameters by preferentially cutting the smaller diameter trees. Development of understories of shade-tolerant conifers would be inhibited because the overstory would be too dense, even after thinning, to allow growth of shade-tolerant conifers in the understory.

Stands <21 years of age would be pre-commercially thinned to two levels of residual density: 110 or 150-200 Douglas-fir TPA. Stands would not be treated between ages 21 and 40 (the stands in those age classes that are shown as treated are those that would be expected to be treated beyond the 10-year span of the proposed plan, when the stands are >40 years old).

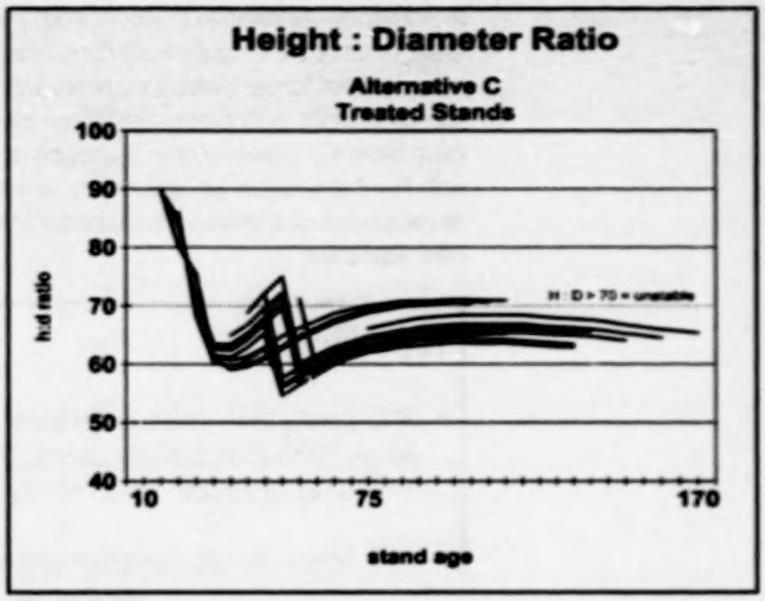
Stands 41-50 years of age would be thinned to 60-110 Douglas-fir TPA. Cut trees would typically be 8"-14" dbh. At the end of the 100-year analysis period, these treatments would result in 45-50 TPA and a relative density of 45-50, below the point at which density-dependent mortality would begin (see Graphs 20 and 21). Crown ratios would remain near 50%. The overstory would be open enough to allow establishment of shade-tolerant conifers, but growth would be suppressed, and understory trees would either remain small or eventually die. These stands would develop height:diameter ratios around 65, which would generally be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 22).



Graph 20.



Graph 21.



Graph 22.

Stands 51-80 years of age would be thinned to 50-110 Douglas-fir TPA. Cut trees would typically be 8"-16" dbh. At the end of the analysis period, these treatments would result in about 40 TPA and a relative density of approximately 45, below the point at which density-dependent mortality would begin (see Graphs 20 and 21). Crown ratios would remain near 50%. The overstory would be open enough to allow establishment of shade-tolerant conifers, but growth would be suppressed, and understory trees would either remain small or eventually die. For example, Figures 27 and 28 illustrate the development of the 30-year-old stand, showing the thinning treatment (note that the stand is not thinned until 2027), and the moderately dense, uniform structure of the stand in 2097. These stands would develop height:diameter ratios around 65, which would generally be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 22).

**Table 4. - Stand Treatment and Results Summary Alternative C**

| STAND TREATMENT AND RESULTS | | STAND AGE | | | |
|---|---|---|---|---|---|
| | | <21 | 21-40 | 41-50 | 51-80 |
| **Thinning prescription (during 10-year span of proposed plan)** | **TPA*** | 110<br>150-200 | Untreated | 60-110 | 110<br>150-200 |
| **Resulting Stand Characteristics (end of 100-year analysis period)** | **TPA** | | | 45-50 | |
| | **RD** | | | 45-50 | |
| | **H:D** | | | 65 | |

*Uplands and 100-foot riparian areas would receive same treatments

In summary, Alternative C would treat a small portion of the young stands in the planning area, and the thinning prescriptions would do little to speed the development of late-successional forest structural characteristics. The thinning prescriptions would create stands of trees with moderately large diameters that are likely to be moderately stable (see Table 4). However, the approach in Alternative C of a single thinning from below with few if any follow-up treatments would retain too much overstory density to allow the development of a shade-tolerant conifer understory and would not spread the range of tree diameters.

## KEY POINTS

- 900 acres (6%) would be treated over 10 years; a total of 3,900 acres (28%) of stands currently 80 years old would be treated including probable treatments beyond 10 years.
- 100 acres would develop late-successional structure.
- Thinning would not effectively speed development of late-successional structure, but stands would likely be stable.

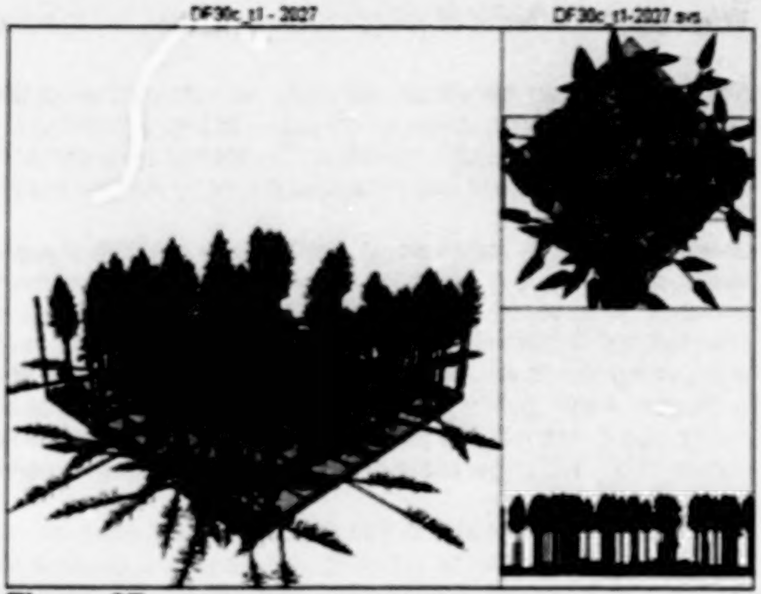


**Figure 27.** *Thinning of the 30-year-old Type Stand*

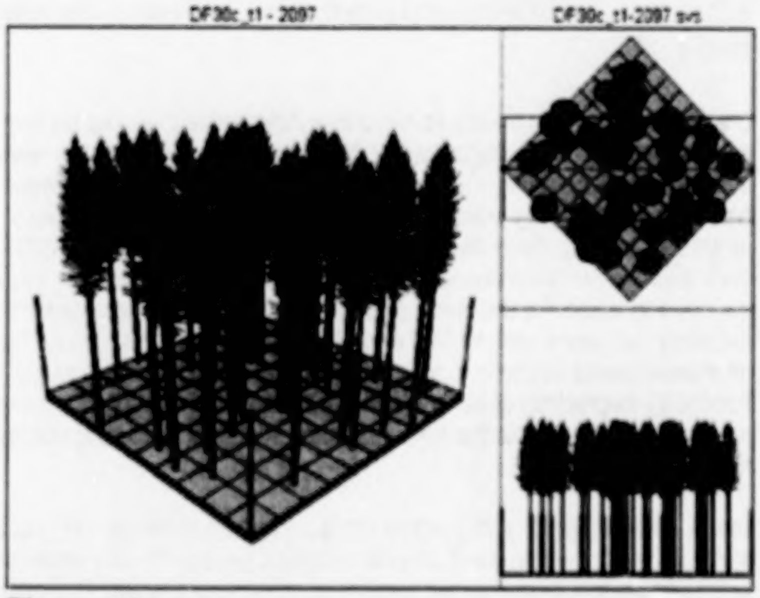


**Figure 28.** *Development of the 30-year-old Type Stand*

## ISSUE 5: *What are the effects of restoration activities on marbled murrelet habitat?*

Alternative C would thin stands ≤80 years old, but would avoid adverse effects to marbled murrelets by evaluating stands 51-80 years old prior to thinning to determine if stands are potential habitat for marbled murrelets. Stands that are potential habitat would be thinned only if surveys find the stands to be unoccupied by marbled murrelets.

Under Alternative C, stands would develop trees ≥32" dbh at approximately the same rate as in Alternative A. However, Alternative C would speed the development of large branches. In 50 years, 1,200 acres would have at least one tree per acre with at least one branch 5" in diameter, twice the amount in Alternative A. In Alternative C, nearly all of the young stands would have at least one tree per acre with at least one branch 5" in diameter within the100-year analysis period (13,300 acres or 96%). The maximum branch size in Alternative C would be only slightly larger than in Alternative A for all age classes (1/3" - 1/2" larger at the end of the 100-year analysis period).

Under Alternative C, no stands that are currently ≤80 years old would achieve target habitat conditions within the 100-year analysis period, because none of the stands would develop a wide enough range of tree diameters, and few stands would support sufficient shade-tolerant conifers.

### KEY POINTS

- All stands would have trees  32" dbh, and almost all would develop branches 5" in diameter within 100 years.
- No young stands would achieve target habitat conditions within 100 years.

## ISSUE 6: *What are the effects of restoration activities on northern spotted owl habitat?*

Development of dispersal habitat under Alternative C would be largely indistinguishable from Alternative A, partly because Alternative C would thin the fewest acres of any action alternative. In addition, thinning prescriptions in Alternative C would maintain dispersal habitat, because they would retain more than 40% canopy closure. Although thinning might temporarily decrease habitat quality (see Anthony et al. 2001, which found that owls avoided recently thinned stands within their home range), the thinned stands would continue to meet the definition of dispersal habitat. Under Alternative C, most of the stands currently  80 years old (13,500 or 98%) would become dispersal habitat in 25 years, and all stands would become dispersal habitat in 30 years. Alternative C may affect critical habitat by degrading existing dispersal habitat, but would not downgrade (i.e., altering the stand conditions below the threshold conditions for dispersal habitat) any existing dispersal habitat.

Under Alternative C, 1,700 acres (12% of stands currently ≤80 years old) would become suitable habitat within the 100-year analysis period. A very small acreage – 100 acres (<1%) – would achieve target habitat conditions within the 100-year analysis period. (The acreage achieving target habitat conditions would decline from 400 acres in ninety years, because shade-tolerant conifers in the understory would die as the stand density would increase).

### KEY POINTS

- All young stands would develop into dispersal habitat, similar to Alternative A.
- 1,700 acres would develop into suitable habitat within 100 years.
- 100 acres would achieve target habitat conditions within 100 years.

## ISSUE 7: *What are the effects of restoration activities on coho salmon habitat?*

**In-stream structure:** Alternative C would construct a minimum of 56 in-stream structures per mile, using at least 3 key pieces of wood per structure, in 3.8 miles of 3rd-5th-order streams (see Figure 29). Structures would be augmented with off-site materials (e.g., large logs and boulders) and cabled as needed to assure structural stability. These structures would persist after a 50-year flood, because of the stabilization of in-stream structures with off-site materials and cabling.

**Figure 29.** *Alternative C would construct in-stream structures using heavy machinery and cabling as needed to assure stability.*

Under Alternative C, trees would be felled or pulled into streams adjacent to upland thinning actions (35.9 miles of 1st-2nd-order streams; 8.0 miles of 3rd-5th-order streams). Alternative C would thin 600 acres (18%) of riparian areas over the 10-year span of the proposed plan, and a total of 1,000 acres (28%) of riparian areas including probable treatments beyond 10 years. Riparian stands would be thinned from below, producing relatively small logs (8"-12" diameter, with some logs 12"-20" diameter). Enough trees would be felled or pulled into streams to add approximately 50-160 trees per mile. These logs would not be stable in 3rd-5th-order streams unless combined in structures with larger logs or cabled, but would generally be stable in 1st-2nd-order streams. This would provide a range of debris concentrations in smaller streams adjacent to upland thinning actions, in some cases meeting the minimum quantity in the ODFW riparian habitat benchmark. Thinned stands would likely not have additional treatments beyond the 10-year span of the proposed plan. Streams adjacent to untreated stands would not receive additional logs, except for the in-stream structures described above.

**Riparian stands:** Alternative C would have effects on the development of large riparian trees ( 24" dbh) similar to all alternatives (See Alternative A, Issue 7). However, it would take considerably longer to develop sufficient density of very large trees that would provide more stable key pieces of woody debris (≥32" dbh): at the end of the 100-year analysis period, approximately 2,500 acres out of 3,400 riparian acres (74%) would have developed ≥13 TPA ≥32" dbh. Alternative C would not thin within 50' of streams, and would use the same thinning prescriptions in the outer portion of the riparian area as in the uplands, which would be only slightly better than Alternative A at speeding the development of very large trees (see Issue 4). Overall, Alternative C would treat fewer riparian acres than any other action alternative. As a result, Alternative C would be only slightly faster than Alternative A (No Action) to develop sufficient density of these larger trees, but slower than all other action alternatives.

**Sedimentation:** Alternative C would have effects on sedimentation from existing roads, road decommissioning, and culvert replacement and removal similar to Alternative B.

Alternative C includes approximately 6.9 miles of new temporary road construction, which would be decommissioned after a single logging season. The new road construction may include approximately 4 temporary stream crossings over the 10-year span of the proposed plan. These stream crossings would cause temporary pulses of approximately 0.4 cubic yards of sediment/year over 10 years from culvert placement and removal.

Construction of in-stream structures in Alternative C would cause temporary pulses of approximately 1.0 cubic yard of sediment/year over 10 years from disturbance to the stream channel bed and banks.

**Barriers:** Alternative C would have effects on fish-barrier culverts and make additional habitat available similar to all action alternatives (See Alternative B, Issue 7).

## KEY POINTS

- Stable in-stream structure would be created on 35.9 miles of 1st-2nd-order streams, and 3.8 miles of 3rd-5th-order streams in 10 years.
- 74% of young riparian forests would develop sufficient density of very large (≥32" dbh) conifers in 100 years.
- Existing road-related sedimentation would be reduced to 74.0 cubic yards/year. Restoration actions and associated road construction would cause a total of 10.4 cubic yards of sediment/year.
- Removal of 10 barrier culverts would open 7.0 miles of new coho salmon habitat.

## ISSUE 8: *How would restoration activities affect the presence and spread of noxious weeds?*

Alternative C would result in some disturbance to both soils and existing vegetation from forest management and aquatic restoration activities in stands ≤80 years old, which could potentially result in further establishment and spread of noxious weeds in treated stands within the planning area.

Decommissioning 24 miles of road would reduce the vectors for the introduction, establishment, and spread of noxious weeds within the planning area, but would be partially offset by the construction of 6.9 miles of new road. However, new road construction would be temporary and would provide vectors for the spread of noxious weeds only until the temporary roads are decommissioned.

Effects on noxious weeds on roads that are not decommissioned would be the same as in Alternative A.

### KEY POINTS

- Decommissioning 24 miles of road would be partially offset by construction of 6.9 miles of new roads and would only slightly reduce noxious weed establishment and spread.

## ISSUE 9: *What would be the economic effects of restoration activities?*

Under Alternative C, there would be 1,400 acres of non-commercial silvicultural treatments, which would generate 36 months of contract work over the entire 10-year span of the proposed plan (1 month of work for silvicultural treatments for each of the first three years of implementation, 7 months of work for each of the second three years, and 3 months of work for each of the final four years).

Decommissioning 24 miles of road would generate 14 months of contract work.

Replacing 10 culverts would generate 11 months of contract work, the same as in all action alternatives.

In-stream restoration would generate 12 months of contract work, the same as in Alternatives D and F.

There would be 900 acres of commercial thinning timber sales over the 10-year span of the proposed plan, which would generate $2.8 million in revenues. Alternative C would have opportunities for revenue from commercial thinning beyond the 10-year span of the proposed plan.

### KEY POINTS

- 69 months of contract work over 10 years.
- $2.8 million of revenue over 10 years.

## ISSUE 10: *What are the costs of restoration?*

For the 10-year span of the proposed plan, silvicultural treatments in Alternative C would incur $171,000 in contract costs and $1.4 million in BLM staff costs (30 work months per year, or $140,000 per year, much of which would be the preparation of timber sales).

Decommissioning 24 miles of road would incur $360,000 in contract costs and $240,000 in BLM staff costs. Culvert replacement costs would be the same as in all action alternatives (see Alternative B). In-stream restoration would incur $80,000 in contract costs and $40,000 in BLM staff costs.

### KEY POINTS

- **$1.4 million in contract costs over 10 years.**
- **$2.1 million in BLM staff costs over 10 years.**

# ALTERNATIVE D (preferred alternative)

## T&E SPECIES RECOVERY

Alternative D is designed to take advantage of restoration opportunities that would have the least short-term adverse effects with the most long-term benefits to habitat for northern spotted owls, marbled murrelets, and coho salmon. All commercial thinning would be completed within the next 10 years. Riparian stands would be thinned without timber removal. In-stream woody debris structures would be constructed, and some structures would be cabled for stability. Alternative D would decommission eroding roads and roads in or adjacent to late-successional forest. New road construction would be limited to short, temporary spur roads.

## ISSUE 1: *How would road decommissioning and road management actions alter public access to BLM-managed lands?*

Under Alternative D, approximately 45 miles of road would be decommissioned (27% of the total 169 miles on BLM-managed land in the planning area), which would reduce road density from the current density of 4.4 miles of road per square mile to approximately 3.2 miles of road per square mile. An additional 12 miles of road are "passively" decommissioning (see Chapter 3). Roads that would be decommissioned under this alternative are shown on Map 4.

Approximately 14 miles legal public access roads (19% of the total 75 miles of legal public access) would be decommissioned. Visitors would be able to enter the public land in question, but that part of the road lying on public land would be decommissioned and would not be accessible by motor vehicle.

Under Alternative D, 31 miles of "other" roads would be decommissioned. ("Other" roads would require crossing private land for which BLM has not obtained a legal easement).

### KEY POINTS

- 45 miles (27%) of road on BLM-administered land would be decommissioned.

## ISSUE 2: *How much new road construction would be needed to implement restoration actions?*

Under Alternative D, there would be no new permanent road construction in order to implement restoration actions. Any new road construction would be restricted to (1) spur roads <200' long, (2) temporary use for a single logging season, and (3) outside of Riparian Reserves with no new stream crossings.

No road construction would be needed to treat stands ≤30 years old, because the existing road system would provide adequate access for thinning.

Under Alternative D, there would be approximately 1,700 acres of 31-40-year-old stands treated. For each treatment unit (averaging 25 acres per unit), 50' on temporary spurs would be constructed. Therefore, approximately 3,400' of spur roads would be constructed to implement restoration actions in the 31-40 year age classes.

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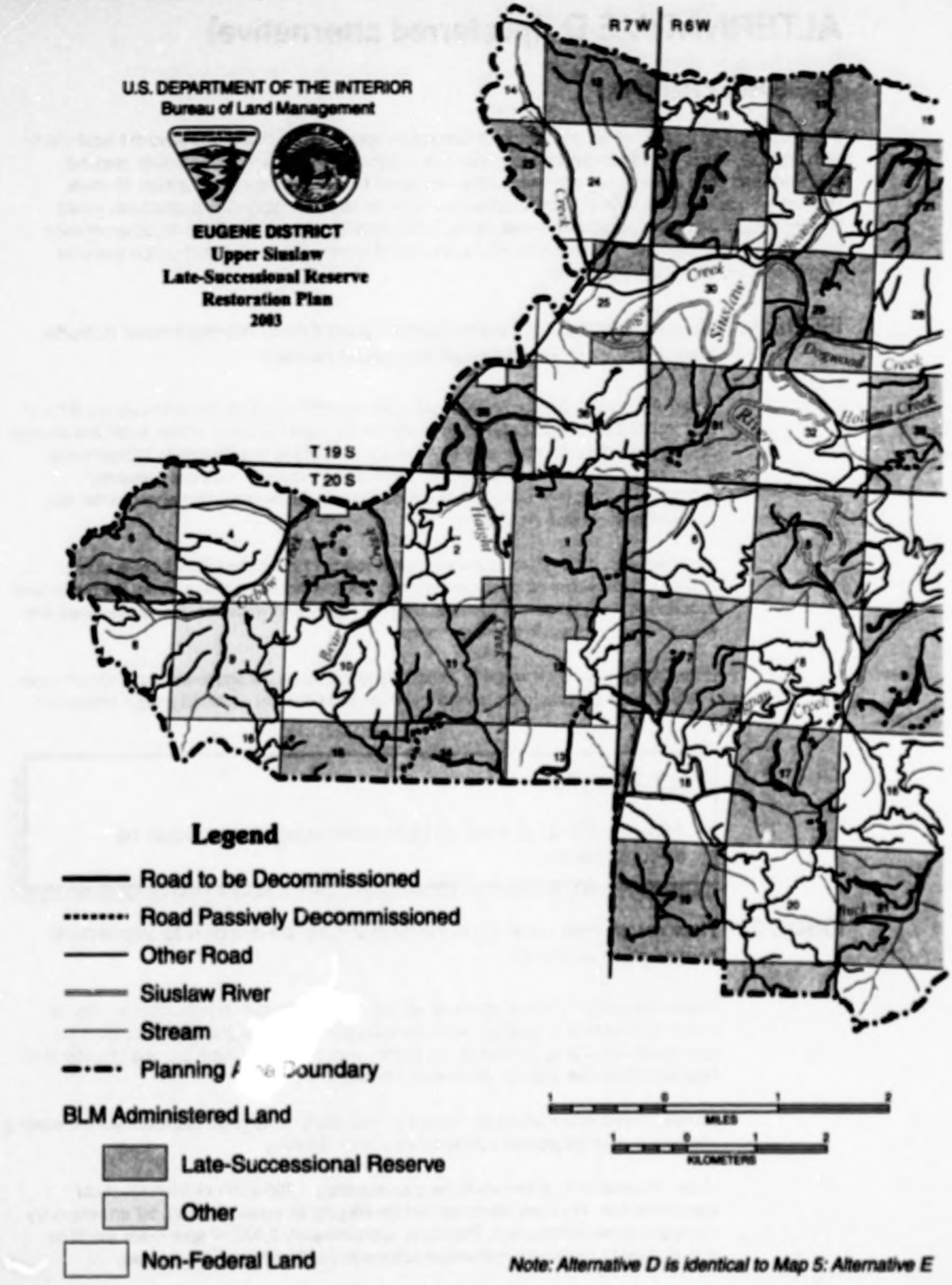

Note: Alternative D is identical to Map 5: Alternative E

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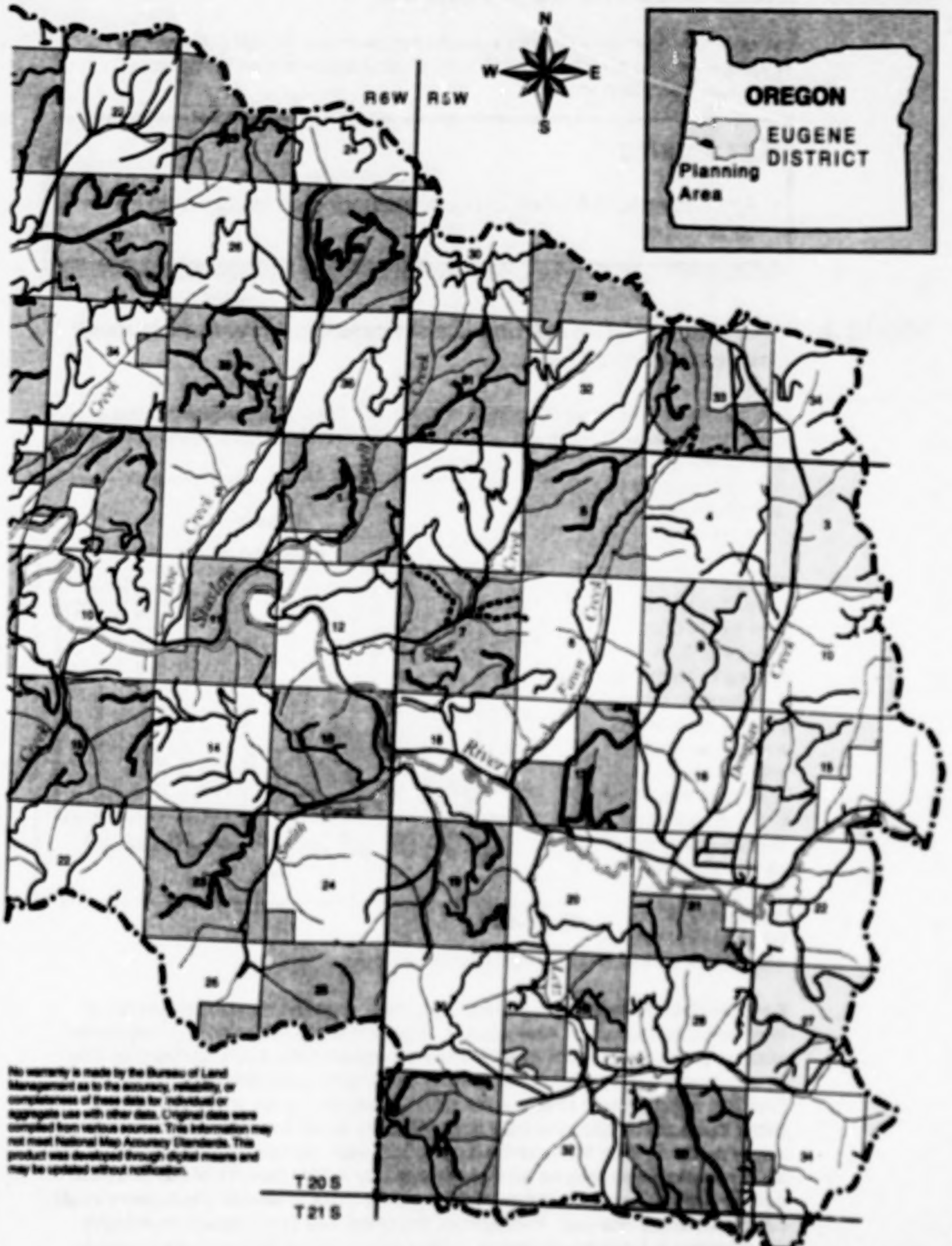
## **Map 4:** Alternative D - Road Decommissioning



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In addition, there are approximately 1,300 acres of 41-60-year-old stands treated under Alternative D. For each treatment unit, 300' of temporary spurs would be constructed. Therefore, approximately 15,480' of spur roads would be constructed to implement restoration actions in the 41-60 year age classes.

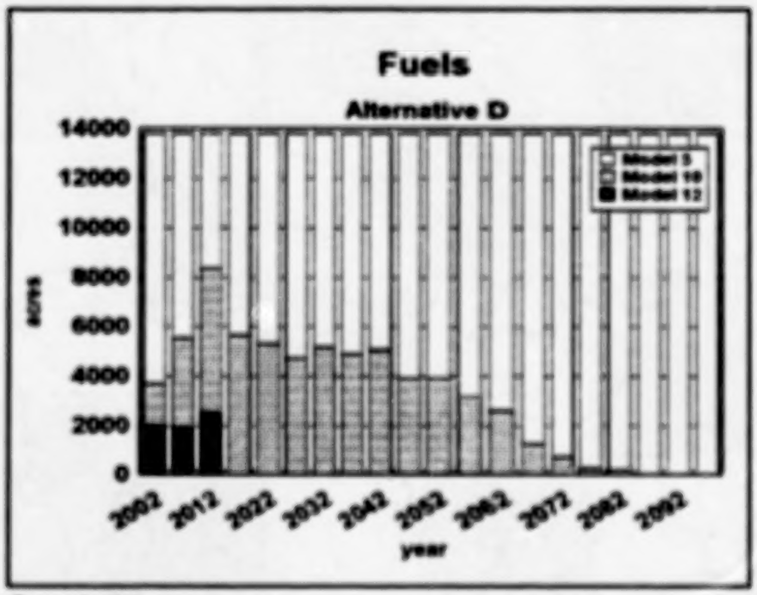
In total, under Alternative D, there would be approximately 3.6 miles of new road constructed during the 10-year span of the proposed plan in order to implement silvicultural restoration actions.

## KEY POINTS

- Approximately 3.6 miles of new temporary spur roads would be constructed.

## ISSUE 3: *What level of risk to existing late-successional forest would result from restoration activities?*

**Fire:** Similar to Alternative B, thinning in Alternative D would immediately create a substantial acreage (2,000 acres) in Fuel Model 12 (see Graph 23). These acres would quickly decrease as the slash would decompose, so that the acres in Model 12 would largely disappear within 15 years. Even more dramatically than Alternative B, the thinning in Alternative D would reduce the acreage in Model 10 and shorten the time before these acres move back into Model 5. For almost all of the 100-year analysis period, Alternative D would maintain the majority of the landscape in Model 5, which presents a much lower risk of catastrophic fire



**Graph 23.**

**Bark Beetles:** At the individual stand scale, there would be some increased risk of bark beetle damage under Alternative D. Approximately 3,000 acres of young stands would experience tree mortality, with a total of approximately 3,000-12,000 trees killed by bark beetles. This relatively low intensity of mortality (approximately 1-4 TPA) would have little effect of stand structure, but would contribute to snag and coarse woody debris levels. Some additional bark beetle mortality would occur following future coarse woody debris creation that would occur on 10-20-year intervals under Alternative D, but such mortality would likely be minor (approximately 4 TPA) because of the moderate quantities of coarse woody debris created and the small acres over which debris would be created in any one year. Furthermore, this effect may be moderated by adaptive management in future coarse woody debris creation efforts: tree mortality caused by bark beetles following one interval of coarse woody debris creation may obviate the need for the next interval of coarse woody debris creation. If a natural disturbance, such as a severe windstorm, were to occur, bark beetles would likely cause additional tree mortality. However, the thinning in Alternative D would create stands that would be relatively stable, which would reduce the likelihood of extensive blowdown (see Issue 4).

At the landscape scale, bark beetle populations would be slightly larger than in Alternative B, because of the greater acreage treated. There would be an increased risk of bark beetle attack on large trees in late-successional stands near thinned, young stands. Otherwise, effects of Alternative D on bark beetle populations would be similar to Alternative B.

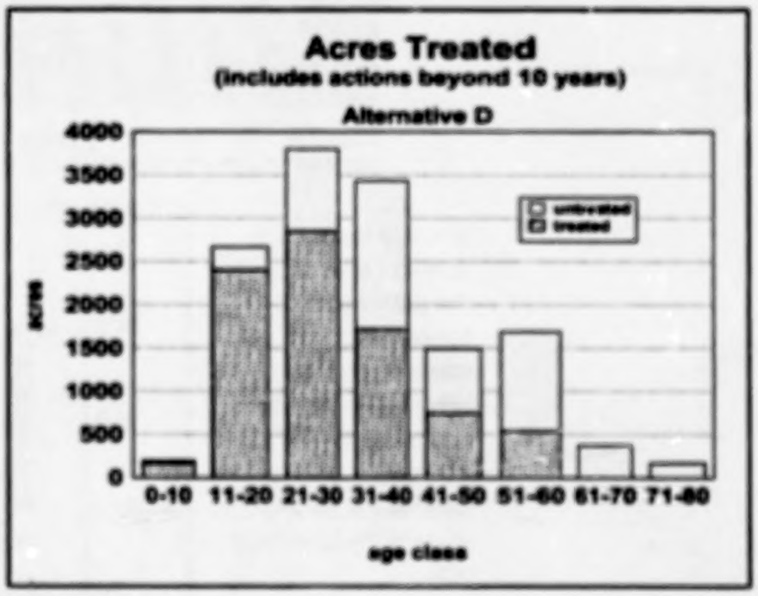
## KEY POINTS

- Thinned stands would move into a low-risk fuel model, substantially reducing the risk of severe fire.
- Bark beetles would likely cause some individual tree mortality, but would not pose a high risk to existing late-successional forests.

## ISSUE 4: *How would thinning affect development of late-successional forest structural characteristics?*

Under Alternative D, approximately 5,400 acres of the 13,800 acres of stands currently 80 years old would receive no treatment and would continue on their existing developmental pathway (see Graph 24). These untreated stands would develop as described under Alternative A.

Alternative D would thin approximately 8,400 acres during the 10-year span of the proposed plan. It is reasonably foreseeable that under the management approach of Alternative D, most or all of these acres would receive additional non-commercial treatments beyond the 10-year span of the proposed plan.

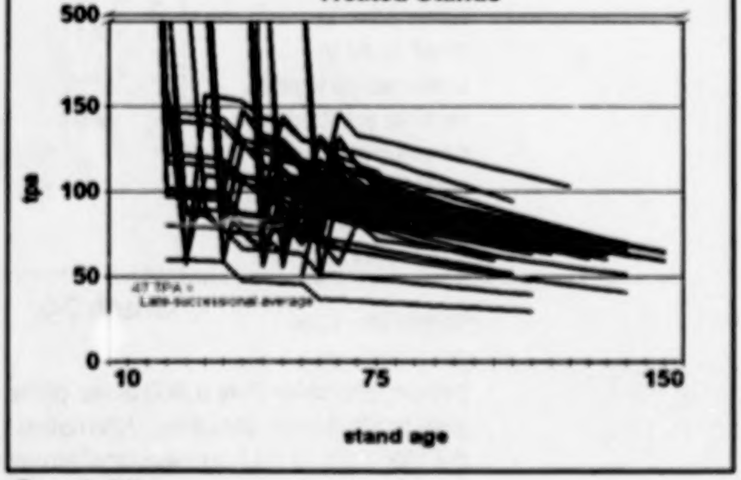


**Graph 24.**

Within the 100-year analysis period, approximately 6,000 acres of the stands currently 80 years old would develop late-successional structure. Alternative D would be more effective at speeding the development of late-successional structure than all other alternatives except Alternative E.

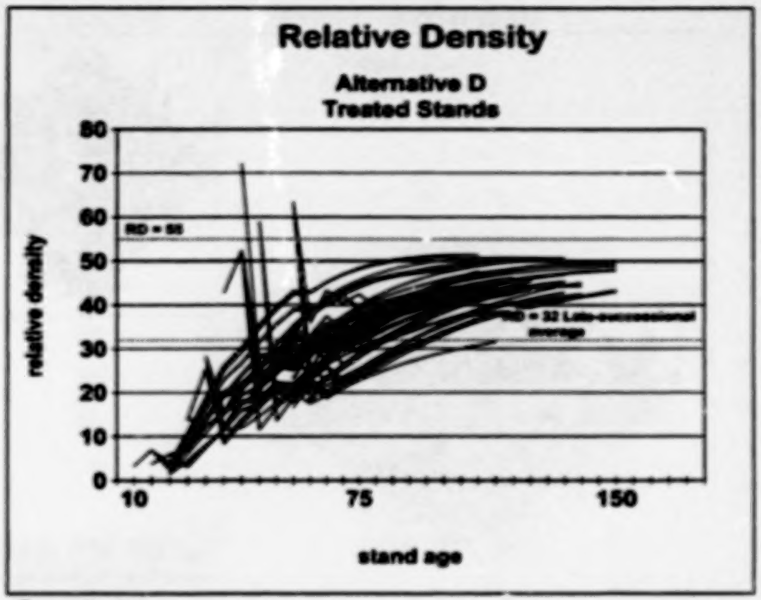
Alternative D would differ from Alternatives B, C, and F in that it would use proportional thinning (which removes trees across all diameters in proportion to their occurrence within the stand). The thinning prescriptions would not be as limited as in Alternative B (see Table 5), because removal of some cut trees in Alternative D would mitigate fuel loadings and bark beetle impacts. Thinning would increase individual tree growth rates and thereby increase stand mean tree diameters. These thinning prescriptions would not reduce the range of tree diameters as in Alternatives B, C, and F, which use thinning from below (preferentially cutting the smaller trees). Alternative D would employ a wide range of thinning prescriptions (see Table 5 and Figure 30). Under most prescriptions, overstory densities would be low enough to permit moderate to good growth of shade-tolerant conifers. Under the lightest thinning prescriptions, development of understories of shade-tolerant conifers would be somewhat inhibited because the overstory would be too dense, even after thinning, to allow growth of shade-tolerant conifers in the understory. The spatially uneven prescriptions of Alternative D would accelerate tree growth in those areas of lower local density. In all of the prescriptions, subsequent treatments would likely cut (or create snags of) 10 TPA at 10-20-year intervals beyond the 10-year span of the proposed plan.

**Figure 30.** *Alternative D would employ a wide variety of thinning prescriptions, many of which create uneven overstories with adundant shade-tolerant conifers in the uderstory.*



Graph 25.

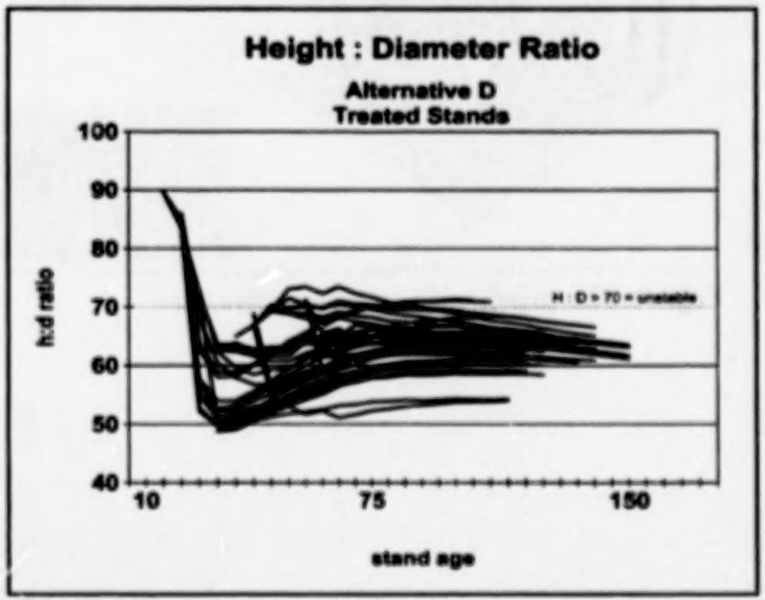
Stands <16 years old would be non-commercially thinned to three levels of residual density: 70, 90, or 135 Douglas-



**Graph 26.**

fir TPA. Stands 16-20 years old would be non-commercially thinned to 50, 70, or 90 Douglas-fir TPA. Riparian stands would be non-commercially thinned to 80 Douglas-fir TPA. The sizes of trees cut would vary between 2"-12" dbh. At the end of the 100-year analysis period, these stands would exhibit a wide range of stand structures: 50-95 TPA (of which 25-60 TPA would be Douglas-fir overstory trees) and stand relative densities between 40-50, below the point at which density-dependent mortality would occur (see Graphs 25 and 26). Most of these stands would develop height: diameter ratios between 60-65, which would generally be stable, but the lightest thinning prescriptions would develop height : diameter ratios between 65-70, which may be less stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 27).

Stands 21-30 years old would be thinned proportionally to 50, 70, or 90 Douglas-fir TPA. Trees between 4"-16" dbh would be cut. Riparian stands and stands that were not pre-commercially thinned would be thinned from below to 80 Douglas-fir TPA, cutting trees between 4"-10" dbh. Cut trees would be left in place within 100' of streams; elsewhere, thinning may include removal of some cut trees, depending upon the size of trees cut, and whether removal is necessary to reduce fuel and bark beetle risk. At the end of the 100-year analysis period, these stands would have 60-75 TPA (of which 25-40 TPA would be Douglas-fir overstory trees) and stand relative densities between 40-50, below the point at which density-dependent mortality would occur (see Graphs 25 and 26). For example, Figures 31 and 32 illustrate the development of the 30-year-old stand, showing the thinning treatment in 2007, and the good development of the shade-tolerant understory in 2097. Though overall stand density at the end of the 100-year analysis period would be similar among the treatments, the stand structure, especially the development of the understory, would vary widely among the treatments (see Figures 33 to 38). All of these stands would develop height: diameter ratios between 55-65, which would generally be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 27).



**Graph 27.**

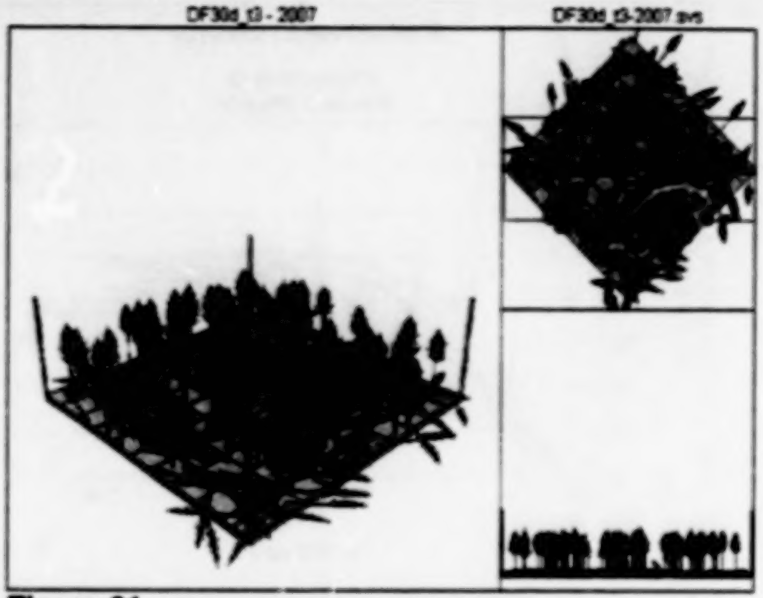


**Figure 31.** *Thinning of the 30-year-old Type Stand*

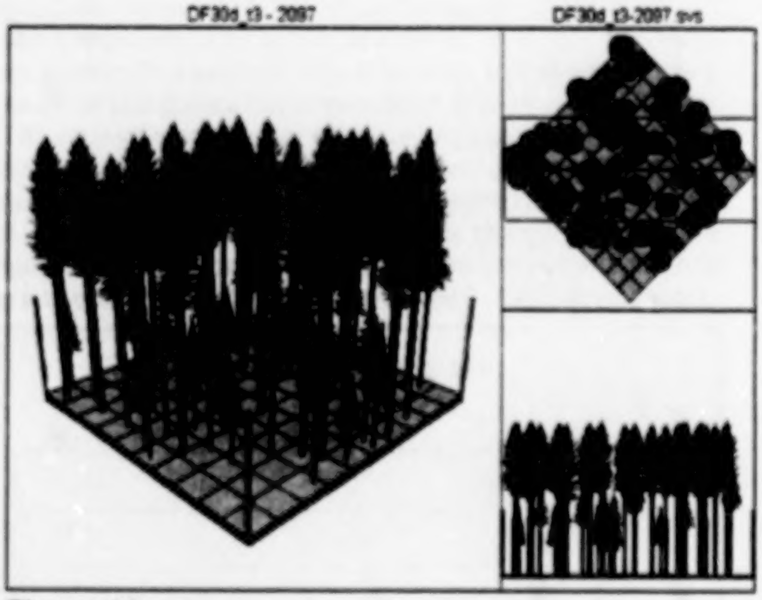


**Figure 32.** *Development of the 30-year-old Type Stand*

Stands 31-40 years old would be thinned proportionally to 50, 70, or 90 Douglas-fir TPA. Riparian stands and stands that were not pre-commercially thinned would be thinned from below to 80 Douglas-fir TPA. Cut trees would be left in place within 100' of streams; elsewhere, thinning would usually include removal of some cut trees to reduce fuel and bark beetle risk. Cut trees would typically be 8"-18" dbh. At the end of the 100-year analysis period, these stands would have 60-70 TPA (of which 25-45 TPA would be Douglas-fir overstory trees) and stand relative densities between 42-50, below the point at which density-dependent mortality would occur (see Graphs 25 and 26). Crown ratios would remain near or above 50%. The overstory would be open enough to allow establishment of shade-tolerant conifers, but growth would be somewhat suppressed in the lightest thinning prescription. In the more open stands, the shade-tolerant understory would show moderate to good growth and begin to reach up to the lower level of the overstory trees. Most of these stands would develop height:diameter ratios between 60-65, which would generally be stable, but the lightest thinning prescriptions would develop height : diameter ratios between 65-70, which may be less stable. (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 27).

Stands 41-60 years old would be thinned proportionally to 50, 70, or 90 Douglas-fir TPA. Riparian stands and stands that were not pre-commercially thinned would be thinned from below to 80 Douglas-fir TPA. Cut trees would be left in place within 100' of streams; elsewhere, thinning would usually include removal of some cut trees to reduce fuel and bark beetle risk. Cut trees would typically be 8"-24" dbh. At the end of the 100-year analysis period, these stands would have 40-70 TPA (of which 25-35 TPA would be Douglas-fir overstory trees) and stand relative densities between 40-50, below the point at which density-dependent mortality would begin (see Graphs 25 and 26). Crown ratios would remain near 50%. The overstory would be open enough to allow establishment of shade-tolerant conifers, but growth would be somewhat suppressed, and understory trees would remain small and considerably below the overstory canopy. Growth of the shade-tolerant understory would not be as vigorous as in stands thinned between 31-40 years old. These stands would develop height:diameter ratios between 60-67, which would generally be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 27).

**Table 5. - Stand Treatment and Results Summary - Alternative D**

| STAND TREATMENT AND RESULTS | | STAND AGE | | | | |
|---|---|---|---|---|---|---|
| | | <16 | 16-20 | 21-30 | 31-40 | 41-55 |
| **Thinning prescription Upland (during 10-year span of proposed plan)** | **TPA** | 70<br>90<br>135 | 50<br>70<br>90 | 50<br>70<br>90 | 50<br>70<br>90 | 50<br>70<br>90 |
| **Thinning prescription Riparian (during 10-year span of proposed plan)** | **TPA** | | 80 | 80 | 80 | 80 |
| **Resulting Stand Characteristics (end of 100-year analysis period)** | **TPA** | 30<br>40<br>50 | 30-35 | 60-70 | 40-70 | 40-70 |
| | **RD** | 30<br>40<br>45 | 30-35 | 40-50 | 42-50 | 40-50 |
| | **H:D** | 55-65 | 60-65 | 55-65 | 60-65 | 60-67 |

**Figure 33**
*Under Alternative D, untreated stands would develop a high-density, uniform condition with no understory of shade-tolerant conifers.*

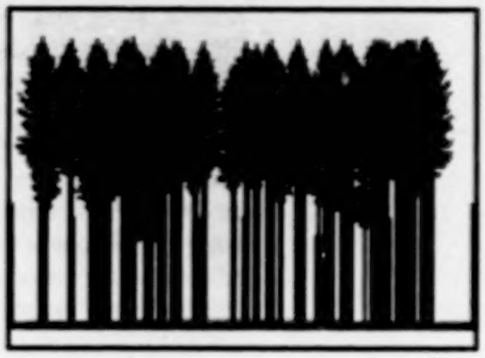


**Figure 34**
*Treatment 1 (proportional thin to 50 TPA) would create a low-density overstory of Douglas-fir, with shade-tolerant conifers growing well into the overstory, creating deep canopy.*

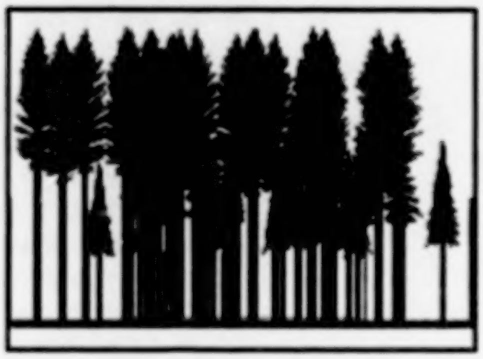
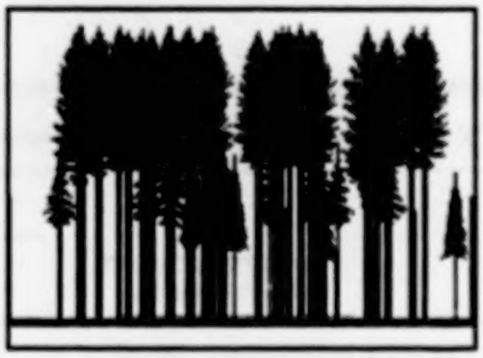


**Figure 35**
*Treatment 2 (proportional thin to 70 TPA) would create a moderate-density overstory of Douglas-fir, with shade-tolerant conifers growing well, though not quite as far into the overstory as Treatment 1.*



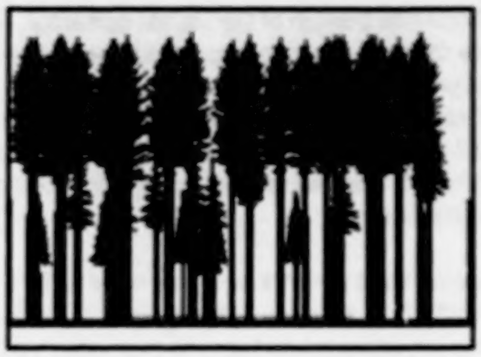


**Figure 36**
*Treatment 3 (proportional thin to 90 TPA) would create a moderate-density overstory of Douglas-fir, with shade-tolerant conifers just reaching the bottom of the overstory.*

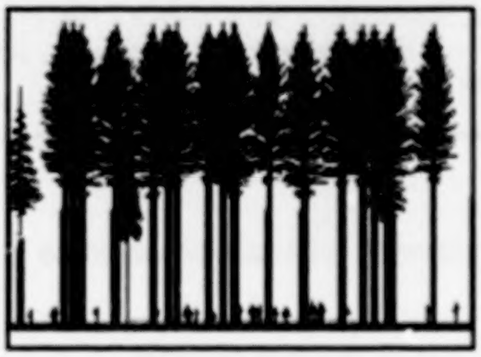


**Figure 37**
*Treatment 4 (thin from below to 80 TPA), which would be applied to stands that had not been pre-commercially thinned, would create an even, moderate-density overstory of Douglas-fir, with small, slow-growing shade-tolerant conifers.*

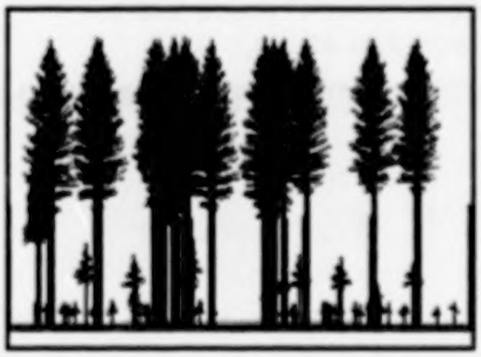


**Figure 38**
*Treatment 5 (thin from below to 80 TPA), which would be applied in riparian areas, would create an uneven, low-density overstory of Douglas-fir, with small shade-tolerant conifers beginning to grow well in response to periodic coarse woody debris creation.*

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In summary, Alternative D would treat a moderate portion of the stands currently ≤80 years old in the planning area, and the thinning prescriptions would speed the development of late-successional forest structural characteristics. The thinning prescriptions would create wide variety of stand structures, in many cases allowing the development of shade-tolerant understories (see Table 5 and Figures 33 to 38, illustrating the various treatments of the 30-year-old stands, and the resultant range of structural conditions at the end of the 100-year analysis period).

Thinning and subsequent planting of shade-tolerant conifers would be most effective in stands 21-40 years old, where cut trees would be removed. In these stands, the thinning would open the overstory enough to allow establishment and growth of shade-tolerant conifers; the relatively low height of the overstory would help delay overstory reclosure while the shade-tolerant trees would grow to a size to become part of the stand structure. It is reasonable to assume that later coarse woody treatments would aid in further delaying overstory reclosure. The proportional thinnings would retain much of the size range of the overstory and allow additional differentiation of the overstory. Thinning in stands 20 years old would be similar to B and would delay the establishment of shade-tolerant understories (see Alternative B, Issue 4 ).

## Key Points

- 8,400 acres (61%) of stands currently 80 years old would be treated over 10 years.
- 6,000 acres would develop late-successional structure.
- Thinning would effectively speed development of late-successional structure, maintaining the range of tree diameters, while allowing growth and establishment of shade-tolerant conifers. Most treated stands would be stable.

## ISSUE 5: *What are the effects of restoration activities on marbled murrelet habitat?*

Alternative D would thin stands ≤60 years old, but would avoid adverse effects to marbled murrelets by evaluating stands 51-60 years old prior to thinning to determine if stands are potential habitat for marbled murrelets. Stands that are potential habitat would be thinned only if surveys find the stands to be unoccupied by marbled murrelets.

Under Alternative D, stands would develop trees ≥32" dbh at approximately the same rate as in Alternative A. However, Alternative D would speed the development of large branches. In 50 years, 6,000 acres would have at least one tree per acre with at least one branch 5" in diameter, faster than all alternatives except Alternative E. In Alternative D, nearly all of the stands currently ≤80 years old would have at least one tree per acre with at least one branch 5" in diameter within 100-year analysis period (13,600 acres or 98%). The maximum branch size in Alternative D would be larger than in Alternative A for all age classes, depending on the treatment prescriptions (1/2" - 1-1/2" larger at the end of the 100-year analysis period).

Under Alternative D, 3,800 acres (28% of stands currently ≤80 years old) would achieve target habitat conditions within the 100-year analysis period. These stands would develop a range of tree diameters, support shade-tolerant conifers, and grow large trees.

### KEY POINTS

- All stands would have trees 32" dbh, and almost all would develop branches 5" and larger within 100 years.
- 3,800 acres of young stands would achieve target habitat conditions within 100 years.

## ISSUE 6: *What are the effects of restoration activities on northern spotted owl habitat?*

Alternative D would both maintain existing levels of dispersal habitat and develop suitable and target habitat conditions. Alternative D would not thin any stands >60 years old. Within current owl home ranges that currently have less than 40% suitable habitat, Alternative D would not thin stands >50 years old. In existing dispersal habitat within current owl home ranges, thinning would retain at least 40% canopy closure. Although such thinning might temporarily decrease habitat quality (see Anthony et al. 2001, which found that owls avoided recently thinned stands within their home range), the thinned stands would continue to meet the definition of dispersal habitat, similar to Alternatives C and F. None of the thinning prescriptions would harvest trees >20" dbh (although some trees >20" dbh would be cut for coarse woody debris creation). As a result of these measures, Alternative D would not adversely affect current owl pairs. Similar to Alternative B, Alternative D would periodically create smaller quantities of snags and coarse woody debris after thinning, which would continue to improve habitat conditions for spotted owl prey species and thereby improve foraging habitat quality.

Under Alternative D, the overall quantity of dispersal habitat would not decrease from current amounts (although some stands that are currently dispersal would be thinned to below 40% canopy closure, other stands would develop into dispersal habitat to maintain or increase the overall acreage). Additional dispersal habitat would develop more slowly than in Alternatives A, B, C, and F. Most of the stands currently ≤80 years old (13,200 or 96%) would become dispersal habitat in 45 years, and all stanus would become dispersal habitat in 55 years.

Alternative D may affect critical habitat by degrading existing dispersal habitat and downgrading (i.e., altering the stand conditions below the threshold conditions for dispersal habitat) some stands outside of owl home ranges. However, the total amount of dispersal habitat in the planning area would not be reduced.

Alternative D would develop more suitable habitat and target habitat conditions than any alternative except Alternative E. Under Alternative D, 6,600 acres (48% of stands currently ≤80 years old) would become suitable habitat within the 100-year analysis period. Almost as much acreage – 6,000 acres (43%) – would achieve target habitat conditions within the 100-year analysis period.

### KEY POINTS

- All young stands would develop into dispersal habitat, but more slowly than Alternatives A, B, C, and F. Dispersal habitat would not decrease from current amounts.
- 6,000 acres would develop into suitable habitat within 100 years.
- 6,600 acres would achieve target habitat conditions within 100 years.

## ISSUE 7: *What are the effects of restoration activities on coho salmon habitat?*

**In-stream structure:** Alternative D would have increase stream complexity on more miles of stream than any other alternative. A minimum of 30 in-stream structures per mile, using at least 3 key pieces of wood per structure, would be installed in 3.8 miles of 3rd-5th-order streams. Similar to Alternative C, structures would be augmented with off-site materials and cabled as needed to assure structural stability. Similar to Alternative C, 3.8 miles of 3rd-5th-order streams would continue to have increased complexity after a 50-year flood, because of the stabilization of in-stream structures with off-site materials and cabling.

Under Alternative D, trees would be felled or pulled trees into all streams adjacent to stands 80 years old (199.5 miles of 1st-2nd-order streams; 44.6 miles of 3rd-5th-order streams). Alternative D would thin 2,200 acres of riparian areas over 10 years (65% of riparian stands 80 years old). Riparian stands would be thinned from below, producing relatively small logs (8"-12" diameter, with some logs 12"-20" diameter). However, all cut trees would be retained in the riparian area, producing large quantities of logs (generally 70-200 TPA). Sufficient trees could be felled directly into streams to add 160 trees/mile (approximately 25 TPA), meeting the minimum quantity in the ODFW riparian habitat benchmark for total pieces of woody debris. These logs would not be stable in 3rd-5th-order streams unless combined in structures with larger logs (such as along 51-80-year-old stands described below), but would generally be stable in 1st-2nd-order streams. Even if these logs were to be moved by a flood in 1st -2nd-order streams, they would generally be caught by stable structures downstream. It is reasonably foreseeable beyond the 10-year span of this proposed plan that 10 TPA would be felled at 10-year intervals in thinned riparian stands, providing logs generally 12"- 24" diameter, with some logs >24" diameter in later treatments.

On streams with riparian stands that would not be otherwise thinned, approximately160 trees/mile would be felled or pulled into the stream, which would provide at least the minimum quantity in the' ODFW benchmark. Similar to Alternative E, it would be possible to create logs ≥24" in diameter from stands >50 years old and thus would be able to create stable in-stream structure in 3rd-5th-order streams adjacent to 51-80-year-old stands (5.8 miles of the 3rd-5th-order streams). In total, Alternative D would be able to create stable in-stream structure on 8.2 miles of 3rd-5th-order streams (up to 3.8 miles by cabling and augmentation, and 5.8 miles by riparian thinning and tree-falling – note that there is some overlap between these two categories).

**Riparian stands:** Alternative D would have effects on the development of large riparian trees ( 24" dbh) similar to all alternatives (See Alternative A, Issue 7). However, it would take considerably longer to develop sufficient density of very large trees that would provide more stable key pieces of woody debris (≥32" dbh): at the end of the 100-year analysis period, approximately 3,100 acres out of 3,400 riparian acres (92%) would have developed ≥13 TPA ≥32" dbh. Alternative D would use

**Figure 39.** *Alternative D, like all action alternatives, would replace or remove high-risk culverts and fish barrier culverts.*

a different prescription in the riparian area than in the uplands and would treat more riparian acres than any alternative except Alternative E. As a result, Alternative D would be faster than all alternatives except Alternative E to develop sufficient density of these larger trees.

**Sedimentation:** Alternative D would have effects on sedimentation from existing roads, road decommissioning, and culvert replacement and removal similar to Alternative B (see Figure 39).

New road construction in Alternative D would be limited to short spurs that would be decommissioned after a single logging season. New road construction would not occur within Riparian Reserves, and no new stream crossings would be constructed. As a result, new road construction under Alternative D would produce negligible if any sediment delivery to streams.

Construction of in-stream structures in Alternative D would have effects similar to Alternative C.

**Barriers:** Alternative D would have effects on fish-barrier culverts and make additional habitat available similar to all action alternatives (See Alternative B, Issue 7).

### KEY POINTS

- Stable in-stream structures would be created on 199.5 miles of 1st-2nd-order streams and 8.2 miles of 3rd-5th-order streams in 10 years.
- 92% of young riparian forests would develop sufficient density of very large (≥32" dbh) conifers in 100 years.
- Existing road-related sedimentation would be reduced to 74.0 cubic yards/year. Restoration actions would cause a total of 10.0 cubic yards of sediment/year.
- Removal of 10 barrier culverts would open 7.0 miles of new coho salmon habitat.

## ISSUE 8: *How would restoration activities affect the presence and spread of noxious weeds?*

Alternative D would result in some disturbance to both soils and existing vegetation from forest management and aquatic restoration activities in stands ≤60 years old, which could potentially result in further establishment and spread of noxious weeds in treated stands within the planning area.

Decommissioning 45 miles of road would reduce the vectors for the introduction, establishment, and spread of noxious weeds within the planning area. Alternative D would include only 3.6 miles of new road construction, which would be temporary and would provide vectors for the spread of noxious weeds only until the roads are decommissioned.

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Effects on noxious weeds on roads that are not decommissioned would be the same as in Alternative A.

### Key Points

- **Decommissioning 45 miles of road would be only slightly offset by construction of 3.6 miles of new roads and would reduce noxious weed establishment and spread.**

## ISSUE 9: *What would be the economic effects of restoration activities?*

Under Alternative D, 5,500 acres would be treated with non-commercial silvicultural treatments, which would generate an estimated 195 months of contract work over the entire 10-year span of the proposed plan. There would be 11 month of work for silvicultural treatments for each of the first three years of implementation, 38 months of work for each of the second three years, and 11 months of work for each of the final four years.

Decommissioning 45 miles of road would generate 18 months of contract work.

Replacing 10 culverts would generate 11 months of contract work, the same as in all action alternatives.

In-stream restoration would generate 12 months of contract work, the same as in Alternatives C and F.

There would be 3,100 acres of commercial thinning timber sales over the 10-year span of the proposed plan, which would generate $11.6 million in revenues.

### Key Points

- 236 months of contract work over 10 years.
- $11.6 million of revenue over 10 years.

## ISSUE 10: *What are the costs of restoration?*

For the 10-year span of the proposed plan, silvicultural treatments in Alternative D would incur $920,000 in contract costs and $5.5 million in BLM staff costs (122 work months per year, or $550,000 per year, much of which would be the preparation of timber sales).

Decommissioning 45 miles of road would incur $675,000 in contract costs and $450,000 in BLM staff costs. Culvert replacement costs would be the same as in all action alternatives (see Alternative B). In-stream restoration would incur $80,000 in contract costs and $40,000 in BLM staff costs.

### Key Points

- $2.4 million in contract costs over 10 years.
- $6.4 million in BLM staff costs over 10 years.

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# ALTERNATIVE E

## REDUCE STAND DENSITIES AS QUICKLY AS POSSIBLE

Alternative E is designed to achieve tree densities typical of local late-successional forests as soon as possible. All commercial thinning would be completed within the next 10 years. Trees would be felled or pulled into all streams adjacent to stands ≤80 years old, but woody debris would not be cabled for stability. Alternative E would decommission eroding roads and roads in or adjacent to late-successional forest. New roads would be constructed as needed.

## ISSUE 1: *How would road decommissioning and road management actions alter public access to BLM-managed lands?*

Under Alternative E, road decommissioning and effects on public access would be the same as in Alternative D.

### KEY POINTS

- 45 miles (27%) of road on BLM-managed land would be decommissioned.

## ISSUE 2: *How much new road construction would be needed to implement restoration actions?*

Under Alternative E, most or all of the new road construction would be temporary construction; the new roads would be decommissioned and blocked following the completion of thinning operations. It is possible, but unlikely, that a portion of the new road construction would need to be permanent road construction with gravel or paved surface. Although there would be no permanent stream crossings, temporary crossings would be likely to occur, but would be single-season use only.

No road construction would be needed to treat the very young (≤20 year old) stands, because the existing road system would provide adequate access for non-commercial thinning.

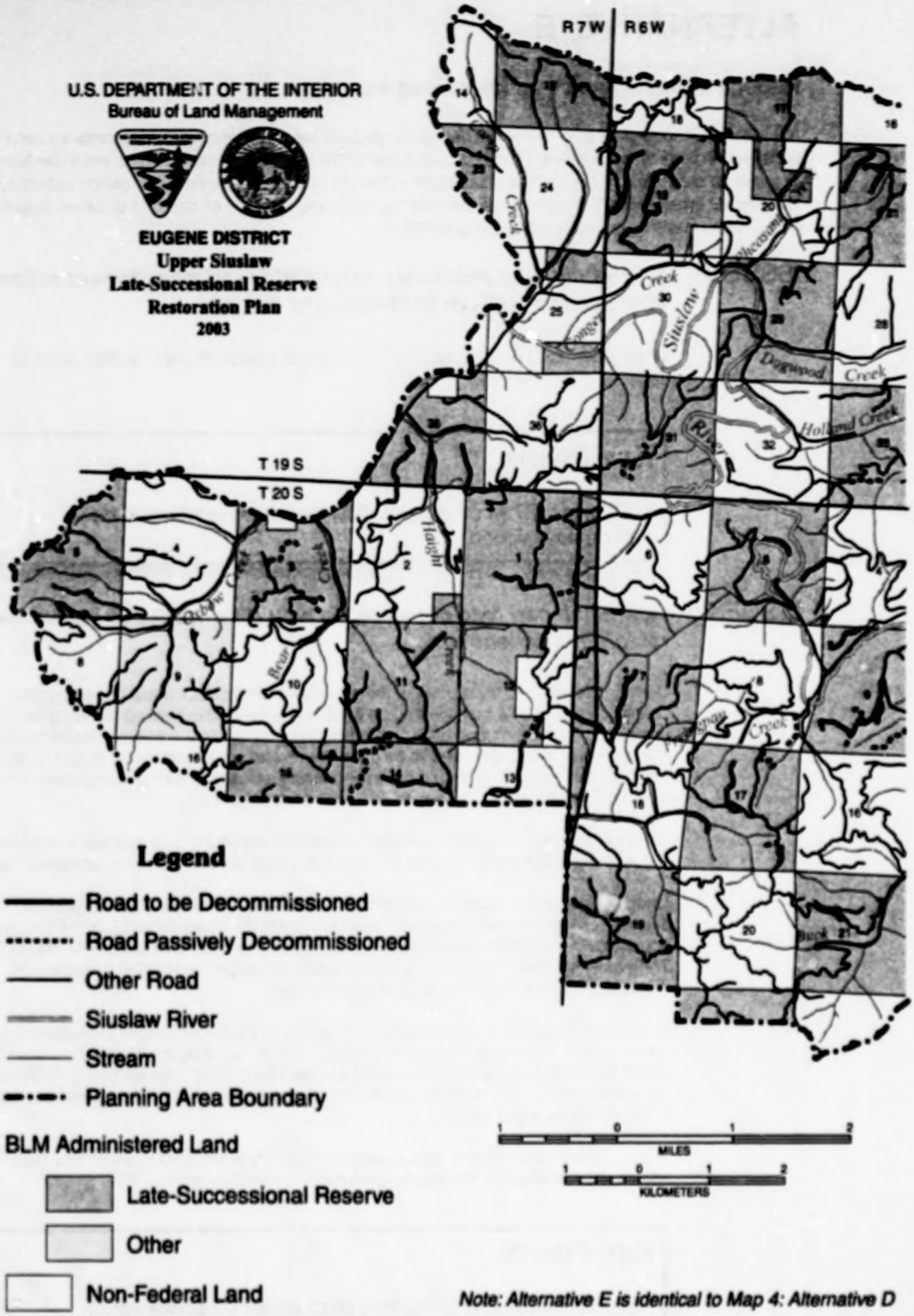
Under Alternative E, there would be approximately 5,400 acres of 21-40-year-old stands treated. For each treatment unit (averaging 25 acres per unit), 50' of temporary spurs would be constructed (the same assumption as described under Alternative D). Therefore, approximately 10,850' of new roads would be constructed to implement restoration actions in the 21-40 year age classes.

In addition, there are approximately 1,680 acres of 41-60-year-old stands treated under Alternative E. For these stands, 40.2' of new roads would be constructed per acre that would harvested (the same assumption as described under Alternative C). Therefore, approximately 67,500' of new road would be constructed to implement restoration actions in the 41-60 year age classes.

In total, under Alternative E, there would be approximately 15.0 miles of new road constructed in order to implement silvicultural restoration actions.

### KEY POINTS

- 15.0 miles of new temporary road would be constructed.



Note: Alternative E is identical to Map 4: Alternative D

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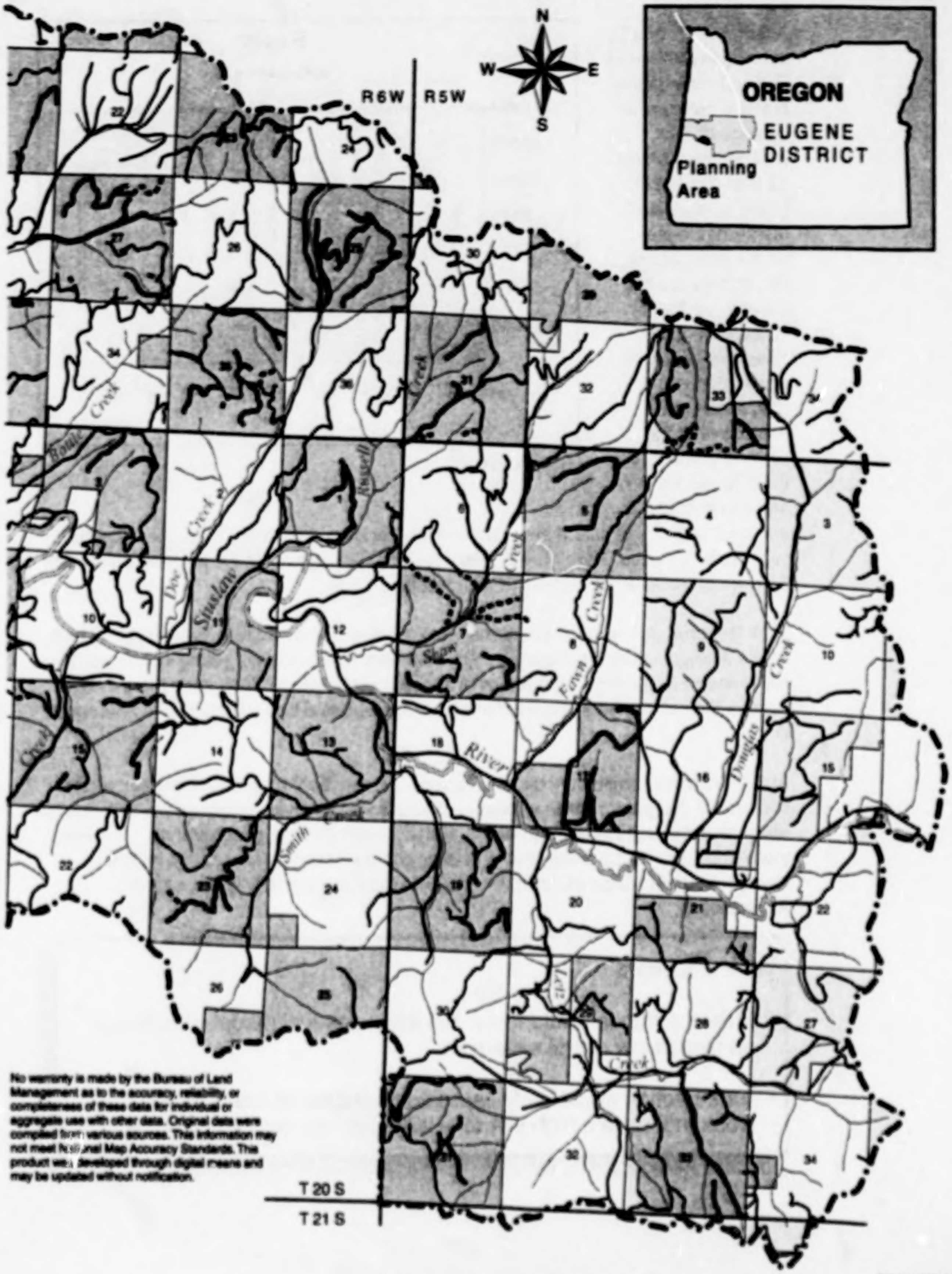
## **Map 5:** Alternative E - Road Decommissioning



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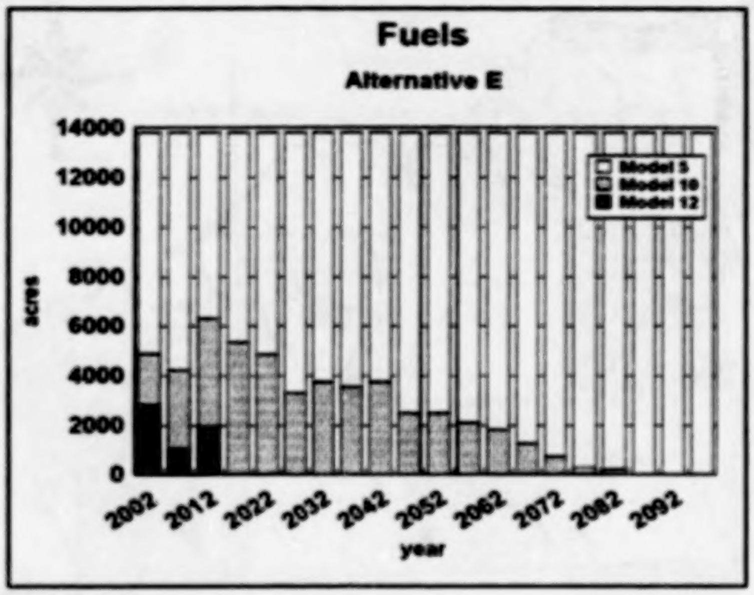
## ISSUE 3: *What level of risk to existing late-successional forest would result from restoration activities?*



Graph 28.

**Fire:** Similar to Alternatives B and D, thinning in Alternative E would immediately create a substantial acreage (2,800 acres) in Fuel Model 12 (see Graph 28). These acres would quickly decrease as the slash would decompose, so that the acres in Model 12 would largely disappear within 15 years. Even more dramatically than Alternative B, the thinning in Alternative E would reduce the acreage in Model 10 and shorten the time before these acres move back into Model 5. Throughout the 100-year analysis period, Alternative E would maintain the majority of the landscape in Model 5, which presents a much lower risk of catastrophic fire.

**Bark Beetles:** At the individual stand scale, there would be some increased risk of bark beetle damage under Alternative E. Approximately 4,300 acres of young stands would experience tree mortality, with a total of approximately 4,300-17,000 trees killed by bark beetles. Otherwise, the stand-level effects of Alternative E would be similar to Alternative D.

At the landscape scale, bark beetle populations would be the highest of all alternatives, because of the greater acreage treated. There would be an increased risk of bark beetle attack on large trees in late-successional stands near thinned, young stands. However, there would still not be a high risk to existing late-successional forests and mitigation measures would still be effective, if needed, at reducing mortality levels, similar to Alternative B.

### KEY POINTS

- Thinned stands would move into a low risk fuel model, resulting in an overall low risk of severe fire.
- Bark beetles would likely cause some individual tree mortality, but would not pose a high risk to existing late-successional forests.

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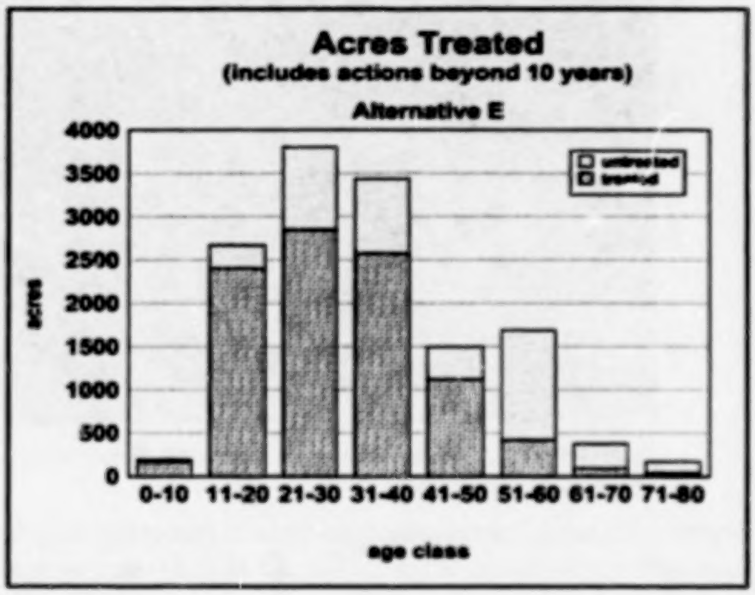
## ISSUE 4: *How would thinning affect development of late-successional forest structural characteristics?*

Under Alternative E, approximately 4,100 acres of the 13,800 acres of young stands would receive no treatment and would continue on their existing developmental pathway (see Graph 29). These untreated stands would develop as described under Alternative A.



**Graph 29.**

Alternative E would thin approximately 9,700 acres during the 10-year span of the proposed plan. It is reasonably foreseeable that under the management approach of Alternative E, most or all of these acres would receive additional non-commercial treatments beyond the 10-year span of the proposed plan.

Within the 100-year analysis period, approximately 8,800 acres of the stands currently ≤80 years old would develop late-successional structure. Alternative E would be the most effective alternative at speeding the development of late-successional structure.

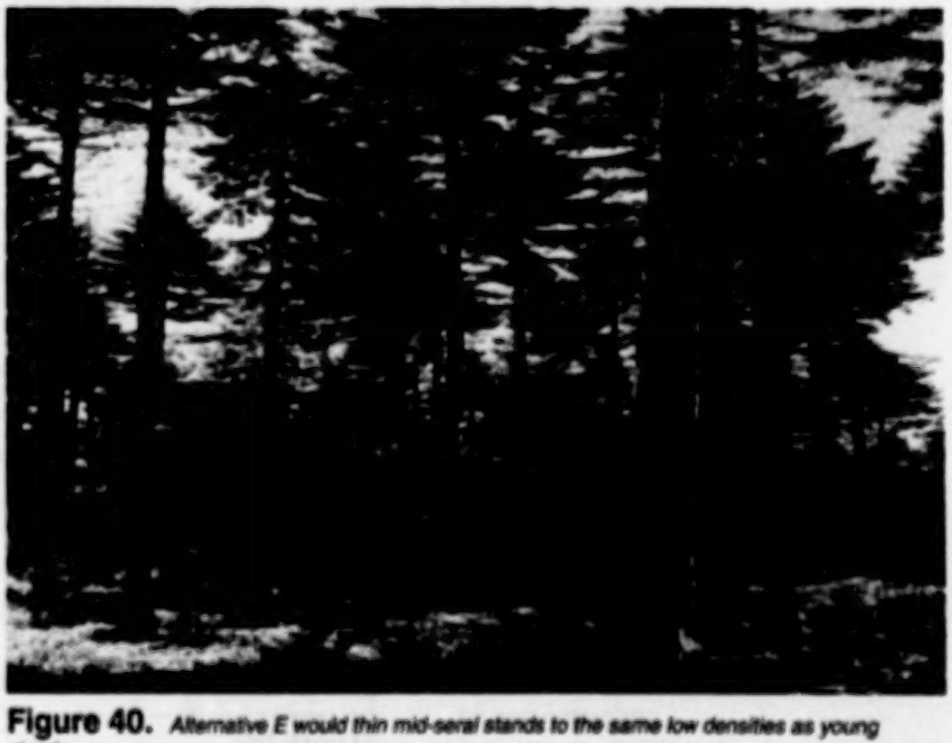
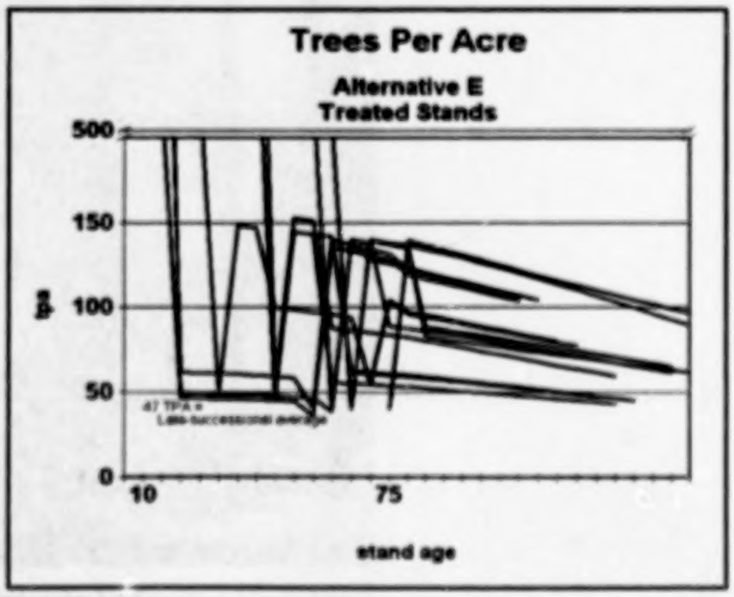


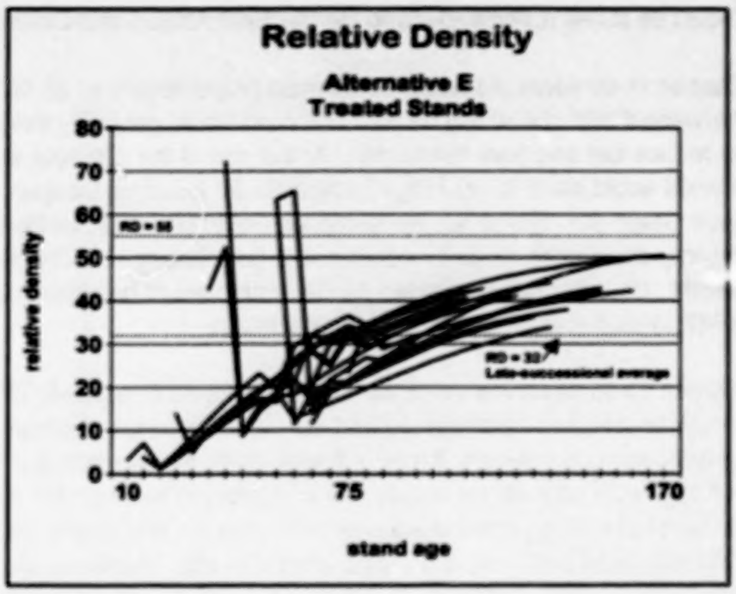
**Figure 40.** *Alternative E would thin mid-seral stands to the same low densities as young stands.*

**Figure 41.** *Alternative E would proportionally thin young stands to low densities with uneven spacing.*

Alternative E would be similar to Alternative D (but would differ from Alternatives B, C, and F) in that it would use proportional thinning (which removes trees across all diameters in proportion to their occurrence within the stand). The thinning prescriptions in stands >20 years old would not be as limited as in Alternative B, because removal of some cut trees in Alternative E would mitigate fuel loadings and bark beetle impacts. Thinning would increase individual tree growth rates and thereby increase stand mean tree diameters. These thinning prescriptions would not reduce the range of tree diameters as in Alternatives B, C, and F, which use thinning from below. Alternative E would employ only relatively heavy thinning prescriptions, thinning stands more heavily than the heaviest prescriptions in Alternative D (see Table 6 and Figures 40 and 41). Under most prescriptions, overstory densities would be low enough to permit good to excellent growth of shade-tolerant conifers. It is reasonable to assume that later coarse woody debris treatments would delay overstory reclosure. Development of understories of shade-tolerant conifers would be somewhat inhibited in older stands, because the overstory would be too dense, even after thinning, to allow for maximum growth of shade-tolerant conifers. Growth of the shade-tolerant understory would likely continue



**Graph 30.**

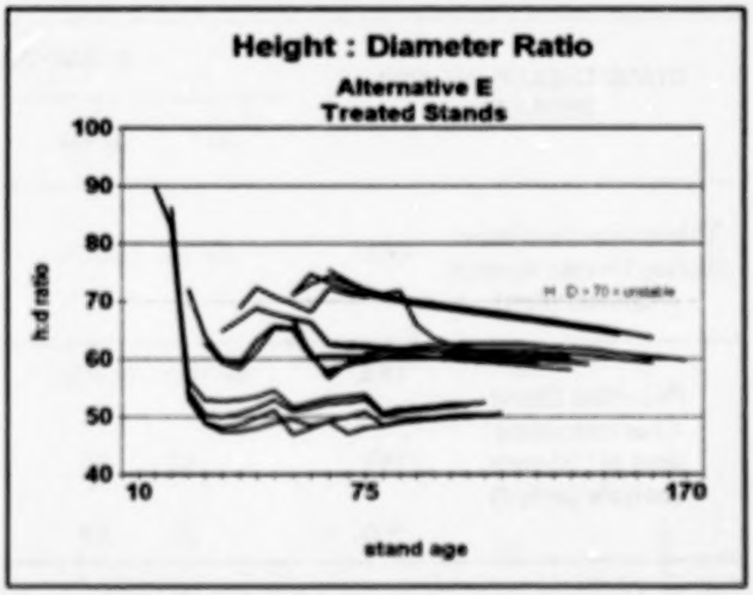


Graph 31.

past the 100-year analytical period, and would result in some stands that have a predominance of western hemlock and western red-cedar. In order to manage the understory density, some non-commercial thinning of the shade-tolerant conifer understory might be necessary.

Stands <21 years old would be non-commercially thinned to 35-55 Douglas-fir TPA. The effect of this thinning would be similar to the heaviest thinning prescription for this age class in Alternative B. Trees between 2"-8" dbh would be cut. By the end of the analytical period, these stands would have 80-100 TPA, of which 20-25 would be Douglas-fir overstory trees. (Graph 30 shows dramatic increases in TPA at stand ages 30-80; these increases result from underplanting). Stand relative densities would be around 40, well below the point at which density-dependent mortality would occur (see Graph 31). Overstory trees would have full crowns. These stands would develop height:diameter ratios around 50, which would be very stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 32).

Stands 21-40 years old would be thinned proportionally to 35-55 Douglas-fir TPA with some removal of cut trees. Trees between 4"-18" dbh would be cut. Thinning would generally include removal of cut trees to reduce fuel and bark beetle risk. At the end of the 100-year analysis period, these stands would have 80-100 TPA, of which 25 -30 would be Douglas-fir overstory trees (see Graph 30). Stand relative densities would be around 40, well below the point at which density-dependent mortality would occur (see Graph 31). For example, Figures 42 and 43 illustrate the development of the 30-year-old stand, showing the thinning treatment in 2002, and the open overstory and good development of the shade-tolerant understory in 2097. These stands would develop height: diameter ratios around 60, which



Graph 32.

would be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 32).

Stands 41-60 years old would be thinned proportionally to 35-55 Douglas-fir TPA. Trees between 4"-20" dbh would be cut. Thinning would generally include removal of cut trees to reduce fuel and bark beetle risk. At the end of the 100-year analysis period, these stands would have 50-90 TPA, of which 25-30 would be Douglas-fir overstory trees (see Graph 30). Stand relative densities would be 40-45, well below the point at which density-dependent mortality would occur (see Graph 31). These stands would develop height : diameter ratios between 60-65, which would be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 32).

Stands 61-80 years old would be thinned to 35-55 Douglas-fir TPA, but some stands would be proportionally thinned and some would be thinned from below, based on site-specific stand conditions. Many of these older, high-density stands with no history of management may not be suitable for proportional thinning: the smaller diameter trees, because of a long period of suppression, may not respond to increased growing space and may be at risk of wind damage after thinning. Therefore, under Alternative E, only half of the treated stands 61-70 years old would be proportionally thinned. The other half of the stands 61-70 years old and all of the treated stands 71-80 years old would be thinned from below. In the proportionally thinned stands, trees between 4"-24" dbh would be cut. In the stands thinned from below, trees between 4"-18" would be cut. Thinning would generally include removal of cut trees to reduce fuel and bark beetle risk. At the end of the 100-year analysis period, under both prescriptions, these stands would have 60-90 TPA, of which 25-30 would be Douglas-fir overstory trees (see Graph 30). Stand relative densities would be 40-50, below the point at which density-dependent mortality would occur (see Graph 31). These stands would develop height:diameter ratios between 60-65, which would be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 32). However, thinning from below appears to reduce dramatically the effectiveness of the treatment at speeding the growth of shade-tolerant conifers and spreading the range of tree diameters, while proportional thinning appears to be effective even in stands 61-70 years old.

In summary, Alternative E would treat a large portion of the stands currently 80 years

## Table 6. - Stand Treatment and Results Summary Alternative E

| STAND TREATMENT AND RESULTS | | STAND AGE | | | |
|---|---|---|---|---|---|
| | | <21 | 21-40 | 41-60 | 61-80 |
| Thinning prescription (during 10-year span of proposed plan) | TPA* | 30-35 | 35-55 | 35-55 | 35-55 |
| Resulting Stand Characteristics (end of 100-year analysis period) | TPA | 80-100 | 80-100 | 50-90 | 60-90 |
| | RD | 40 | 40 | 45-50 | 40-50 |
| | H:D | 50 | 60 | 60-65 | 60-65 |

*Uplands and 100-foot riparian areas would receive same treatments

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old in the planning area, and the thinning prescriptions would speed the development of late-successional forest structural characteristics. Thinning and subsequent planting of shade-tolerant conifers would be most effective in stands 21-60 years old and in the stands 61-70 years old that would be proportionally thinned. Thinned stands would be stable and would be open in character for an extended period of time (see Table 6). Overstory trees would develop and retain large, full crowns. The proportional thinning prescriptions would retain much of the size range of the overstory and allow additional differentiation of the overstory, and would allow development of shade-tolerant understories.

**ISSUE 5:**

## KEY POINTS

- 9,700 acres (70%) of stands currently ≤80 years old would be treated over 10 years.
- 8,800 acres would develop late-successional structure.
- Thinning would most effectively speed development of late-successional structure in stands 21-60 years old and in the stands 61-70 years old that would be proportionally thinned.
- Thinning would be ineffective in stands 61-80 years old that would be thinned from below, but stands would be stable.

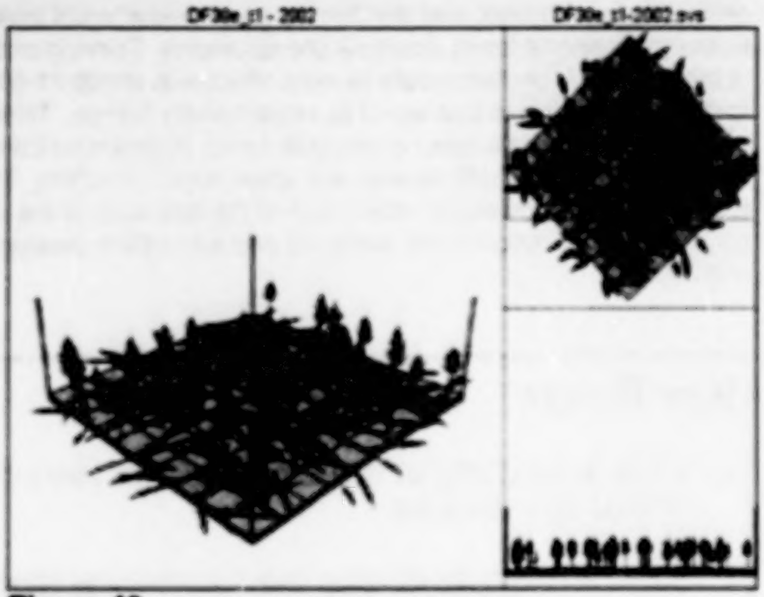

**Figure 42.** *Thinning of the 30-year-old Type Stand*

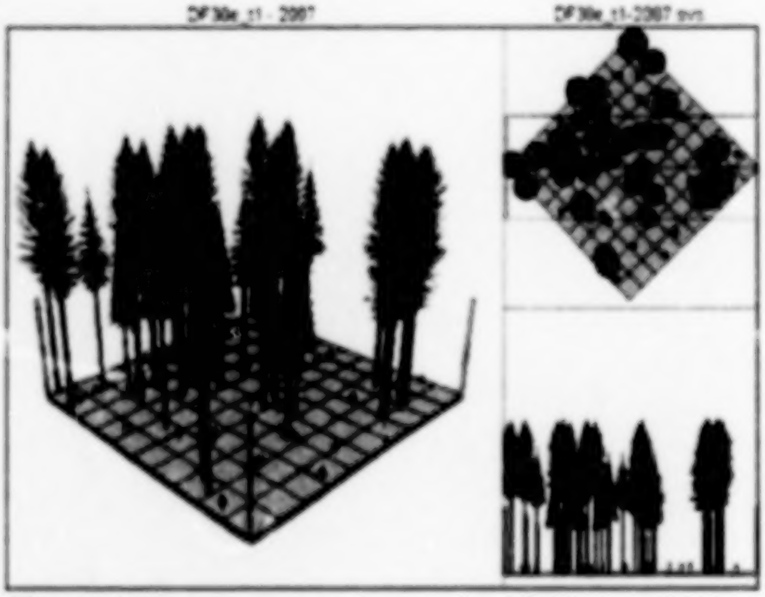

**Figure 43.** *Development of the 30-year-old Type Stand*

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### *What are the effects of restoration activities on marbled murrelet habitat?*

Alternative E would thin stands ≤80 years old, but would avoid adverse effects to marbled murrelets by evaluating stands 50-80 years old prior to thinning to determine if stands are potential habitat for marbled murrelets. Stands that are potential habitat would be thinned only if surveys find the stands to be unoccupied by marbled murrelets.

Under Alternative E, stands would develop trees ≥32" dbh at a faster rate than any other alternative. In addition, Alternative E would speed the development of large branches more than any other alternative. In 50 years, 8,300 acres would have at least one tree per acre with at least one branch 5" in diameter. In Alternative E, nearly all of the stand currently 80 years old would have at least one tree per acre with at least one branch 5" in diameter within the100-year analysis period (13,600 acres or 98%). The maximum branch size in Alternative E would be larger than in Alternative A for all age classes (1-1/2" - 2" larger at the end of the 100-year analysis period).

Under Alternative E, 3,900 acres (28% of stands currently ≤80 years old) would achieve target habitat conditions within the 100-year analysis period. These stands would develop a range of tree diameters, support shade-tolerant conifers, and grow large trees.

## ISSUE 6: *What are the effects of restoration activities on northern spotted owl habitat?*

**KEY POINTS**

- All stands would have trees 32" dbh, and almost all would develop branches 5" and larger (up to 7") within 100 years.
- 3,900 acres of young stands would achieve target habitat conditions within 100 years.

Alternative E would temporarily reduce the amount of dispersal habitat, but would most effectively develop suitable and target habitat conditions nesting habitat. Alternative E would thin stands 80 years old, but would generally avoid thinning stands 51-80 years old within current owl home ranges, and thereby avoid degrading suitable habitat within home ranges. Alternative E may affect critical habitat by reducing the amount of dispersal habitat in the planning area.

Under Alternative E, thinning would drop the amount of current dispersal habitat from 3,700 acres to 2,400 acres in 5 years. Alternative E is the only alternative that would reduce the amount of dispersal habitat below current levels. In 10 years, the amount of dispersal habitat would return to current levels. This 10-year reduction in the amount of dispersal habitat may adversely affect spotted owls. Under Alternative E, additional dispersal habitat would develop more slowly than any other alternative. Most of the stands currently 80 years old (13,000 or 94%) would become dispersal habitat in 60 years, and all stands would become dispersal habitat in 65 years.

Alternative E would develop more suitable habitat and target habitat conditions than any other alternative: 9,600 acres (70% of stands currently ≤80 years old) would become suitable habitat within the 100-year analysis period. Almost as much acreage – 8,800 acres (64%) – would achieve target habitat conditions within the 100-year analysis period.

**KEY POINTS**

- All young stands would develop into dispersal habitat, but more slowly than any other alternative. Dispersal habitat would decrease from current levels for 10 years.
- 9,600 acres would develop into suitable habitat within 100 years.
- 8,800 acres would achieve target habitat conditions within 100 years.

## ISSUE 7: *What are the effects of restoration activities on coho salmon habitat?*

**In-stream structure:** Alternative E would create in-stream woody debris structures, but would differ from Alternatives C, D, and F in that structures would not be cabled to assure structural stability. Alternative E would thin 2,400 acres (70%) of riparian areas and would create approximately 160 pieces/mile of woody debris along all streams with riparian stands ≤80 years old (199.5 miles of 1st-2nd-order streams; 55.4 miles of 3rd-5th-order streams). This quantity would meet the ODFW minimum riparian habitat benchmark for total pieces of woody debris. In most stands, trees felled to the stream would be 8"-20" diameter, generally larger than in all other alternatives. On 1st-2nd-order streams, this woody debris would be generally stable and would result in increased stream complexity of 199.5 miles of 1st -2nd-order streams (although this debris would likely not be stable in the event of a flood larger than the 50-year flood).

Alternative E would be able to create logs ≥24" in diameter from stands >50 years old and thus would be able to create stable in-stream structure in 3rd-5th-order streams adjacent to 51-80-year-old stands (5.8 miles of the 3rd-5th-order streams) (see Figure 44). In 3rd-5th-order streams adjacent to younger stands, the woody debris created would not be stable and would likely be lost from the stream system following a 50-year flood, except on the

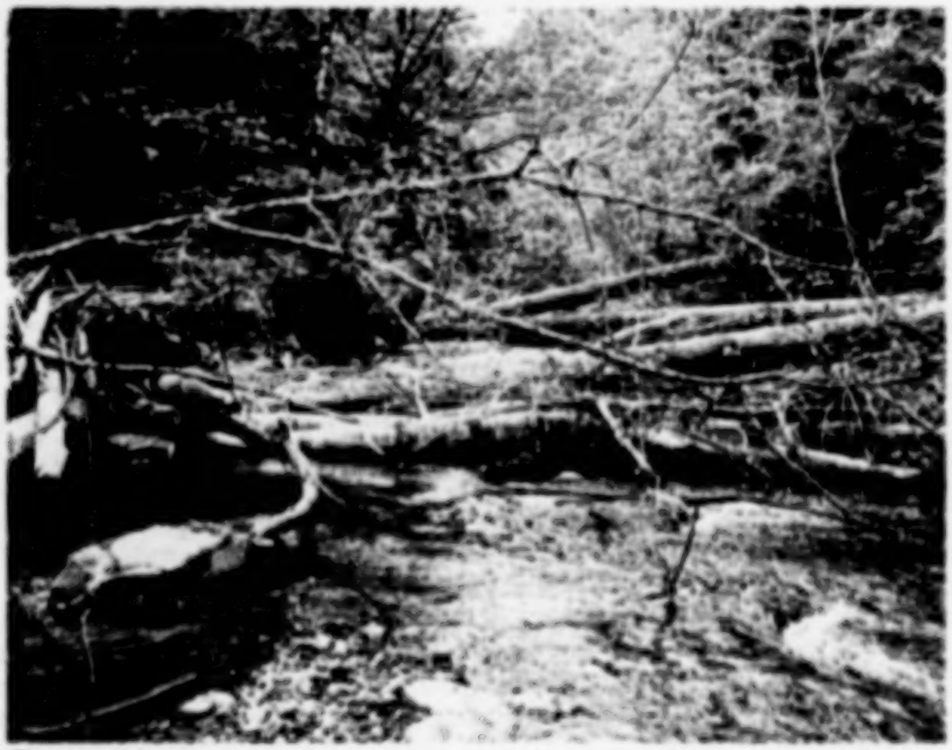

**Figure 44.** *Alternative E would create stable in-stream structure on larger streams adjacent to mid-seral stands.*

five stream systems with existing stable structure (see Chapter 3). It is not reasonably foreseeable that a sufficient number of logs 24" diameter would be available from off-site to make up for this deficit in streams in younger stands. However, beyond the 10-year span of the proposed plan, it is reasonably foreseeable that 5 TPA would be felled at 10-year intervals in thinned riparian stands, providing logs generally 12"-24" diameter, with some logs 24" diameter in later treatments. In approximately 40-50 years, woody debris creation in most stands currently less than 35 years old would be able to provide stable, in-stream structure in 3rd-5th-order streams. Therefore, Alternative E would create stable in-stream structure on 5.8 miles of 3rd-5th-order streams, but woody debris created on other 3rd-5th-order streams would not be stable for the next 40-50 years.

**Riparian stands:** Alternative E would have effects on the development of riparian trees big enough to provide key pieces of woody debris (≥24" dbh) similar to all alternatives (See Alternative A, Issue 7). However, it would take considerably longer to develop sufficient density of very large trees that would provide more stable key pieces of woody debris (≥32" dbh): at the end of the 100-year analysis period, approximately 3,300 acres out of 3,400 riparian acres (95%) would have developed ≥13 TPA ≥32" dbh. Alternative E is faster than all other alternatives to develop sufficient density of these larger trees.

**Sedimentation:** Alternative E would have effects on sedimentation from existing roads, road decommissioning, and culvert replacement and removal similar to Alternative B.

Alternative E includes approximately 15.0 miles of new road construction, which would be decommissioned after a single logging season. The new road construction would include approximately 8 temporary stream crossings over the 10-year plan period, which would cause temporary pulses of approximately 0.8 cubic yards of sediment/year over 10 years from culvert placement and removal.

Alternative E would not construct in-stream structures as would Alternatives C, D, and F, but would fall or pull over trees into streams, which would cause temporary pulses of approximately 1.0 cubic yard of sediment/year over 10 years from disturbance to the stream channel bed and banks.

**Barriers:** Alternative E would have effects on fish-barrier culverts and make additional habitat available similar to all action alternatives (See Alternative B, Issue 7).

## KEY POINTS

- Stable in-stream structure would be created on 199.5 miles of 1st-2nd-order streams, and 5.8 miles of 3rd-5th-order streams in 10 years.
- 95% of young riparian forests would develop sufficient density of very large (≥32" dbh) conifers in 100 years.
- Existing road-related sedimentation would be reduced to 74.0 cubic yards/year. Restoration actions and associated road construction would cause a total of 10.8 cubic yards of sediment/year.
- Removal of 10 barrier culverts would open 7.0 miles of new coho salmon habitat.

## ISSUE 8: *How would restoration activities affect the presence and spread of noxious weeds?*

Alternative E would result in some disturbance to both soils and existing vegetation from forest management and aquatic restoration activities in stands 80 years old, which could potentially result in further establishment and spread of noxious weeds in treated stands within the planning area.

The decommissioning of 45 miles of road would reduce the vectors for the introduction, establishment, and spread of noxious weeds within the planning area, but would be partially offset by the construction of 15.0 miles of new road, the most new road construction of any alternative. However, new road construction would be temporary and would provide vectors for the spread of noxious weeds only until the temporary roads are decommissioned.

Effects on noxious weeds on roads that are not decommissioned would be the same as in Alternative A.

### KEY POINTS

- Decommissioning 45 miles of road would be partially offset by construction of 15.0 miles of new roads, but would reduce noxious weed establishment and spread.

## ISSUE 9: *What would be the economic effects of restoration activities?*

Under Alternative E, 9,700 acres would be treated with non-commercial silvicultural treatments, which would generate approximately 320 months of contract work over the entire 10-year span of the proposed plan. There would be 100 months of work for silvicultural treatments for each of the first three years of implementation, 130 months of work for each of the second three years, and 90 months of work for each of the final four years.

Decommissioning 45 miles of road would generate 18 months of contract work, the same as in Alternative D.

Replacing 10 culverts would generate 11 months of contract work, the same as in all action alternatives.

Falling and pulling riparian trees for in-stream structure would generate 35 months of contract work (23 months for falling 160 trees per mile over 77 miles, and 12 months for pulling and yarding 2 trees per mile over 77 miles).

There would be approximately 3,900 acres of commercial thinning timber sales within the 10-year period, which would generate $20.2 million in revenues

### KEY POINTS

- 384 months of contract work over 10 years.
- $20.2 million of revenue over 10 years.

## ISSUE 10: *What are the costs of restoration?*

For the 10-year span of the proposed plan, silvicultural treatments in Alternative E would incur approximately $2.23 million in contract costs and $9.7 million in BLM staff costs (220 work months per year, or $970,000 per year, much of which would be the preparation of thinning timber sales).

Road decommissioning costs would be the same as in Alternative D. Culvert replacement costs would be the same as in all action alternatives (see Alternative B). In-stream restoration would incur $190,000 in contract costs and $75,000 in BLM staff costs.

### KEY POINTS

- $3.9 million in contracts over 10 years.
- $10.6 million in BLM staff costs over 10 years.

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# ALTERNATIVE F

## MULTI-ENTRY AND MULTI-TRAJECTORY THINNING

Alternative F is designed to accomplish restoration using multiple thinning of stands to maintain stand vigor and develop stand stability while maintaining canopy closure. In-stream woody debris structures would be constructed on larger streams, and some structures would be cabled for stability. Alternative F would decommission eroding roads and roads in late-successional forest and would construct new roads as needed.

### ISSUE 1: *How would road decommissioning and road management actions alter public access to BLM-managed lands?*

Alternative F is similar to Alternative C in terms of the miles of road that would be decommissioned. Under the multiple commercial thinning scenario of Alternative F, a permanent road network would be necessary, limiting opportunities for road decommissioning.

**KEY POINTS**

- 24 miles (14%) of road on BLM-managed land would be decommissioned.

### ISSUE 2: *How much new road construction would be needed to implement restoration actions?*

Under Alternative F, most or all of the new road construction would be temporary construction; the new roads would be decommissioned and blocked following the completion of thinning operations. Even though many roads would need to be reused for future thinning, new road construction would be decommissioned between stand entries. It is possible, but unlikely, that a portion of the new road construction would need to be permanent road construction with gravel or paved surface. Although there would be no permanent stream crossings, temporary crossings would be likely to occur, but would be single-season use only.

No road construction would be needed to treat the very young (≤24 year old) stands, because the existing road system would provide adequate access for pre-commercial thinning.

Under Alternative F, there would be approximately 3,055 acres of 25-40 year old stands treated. For each treatment unit (averaging 25 acres per unit), 50' of temporary spurs would be constructed (the same assumption as described under Alternative D). Therefore, approximately 6,100' of new road would be constructed to implement restoration actions in the 25-40 year age classes.

In addition, there are approximately 1,350 acres in the 41-80-year-old stands treated under Alternative F. For these stands, 40.2' of new road would be constructed per acre that would harvested (the same assumption as described under Alternative C). Therefore, approximately 52,270' of new road would be constructed to implement restoration actions in the 41-80 year age classes.

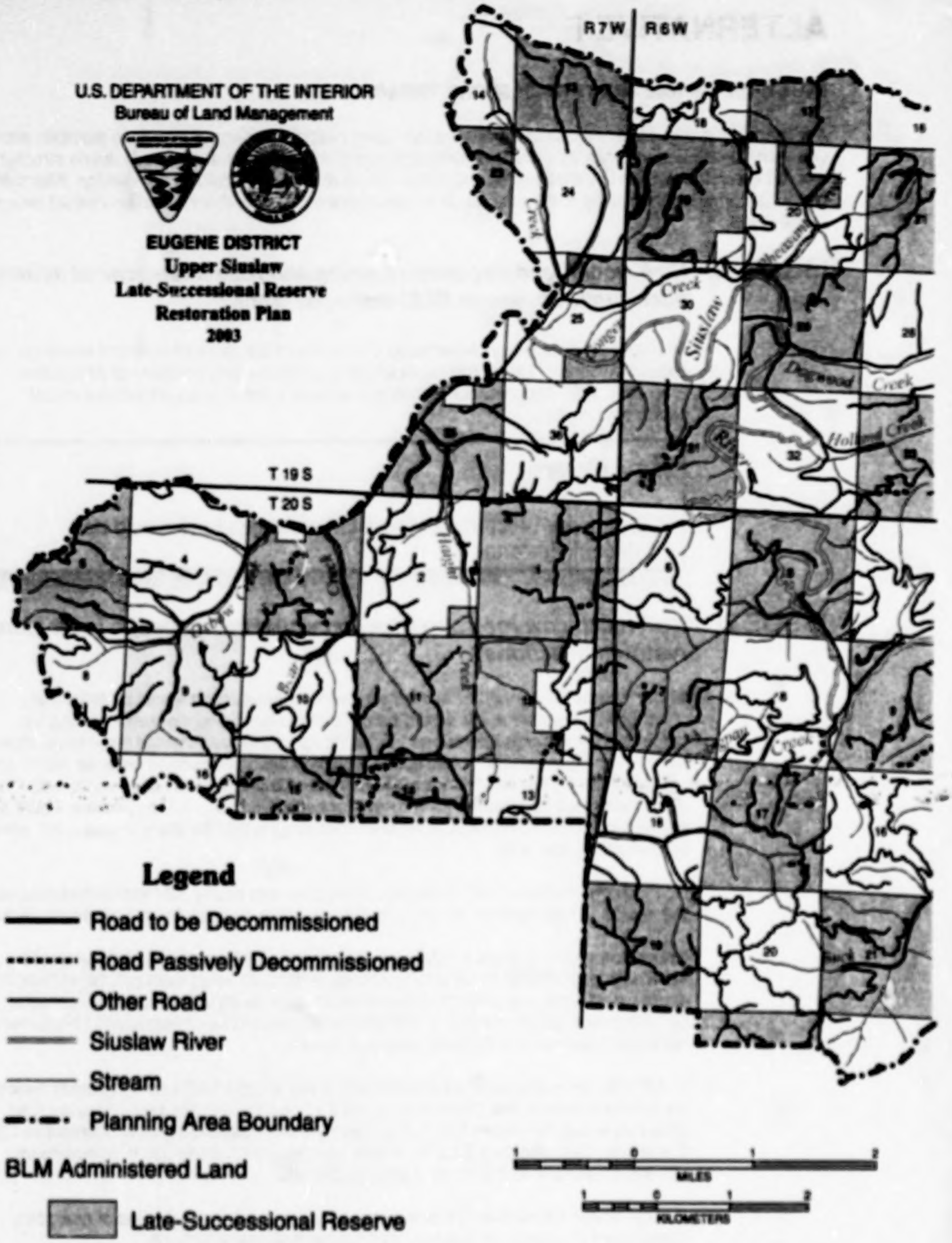
In total, under Alternative F, there would be approximately 11.5 miles of new road constructed in order to implement silvicultural restoration actions.

**KEY POINTS**

- 11.5 miles of new temporary road would be constructed.

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management

**EUGENE DISTRICT**
**Upper Siuslaw**
**Late-Successional Reserve**
**Restoration Plan**
**2003**



## Legend

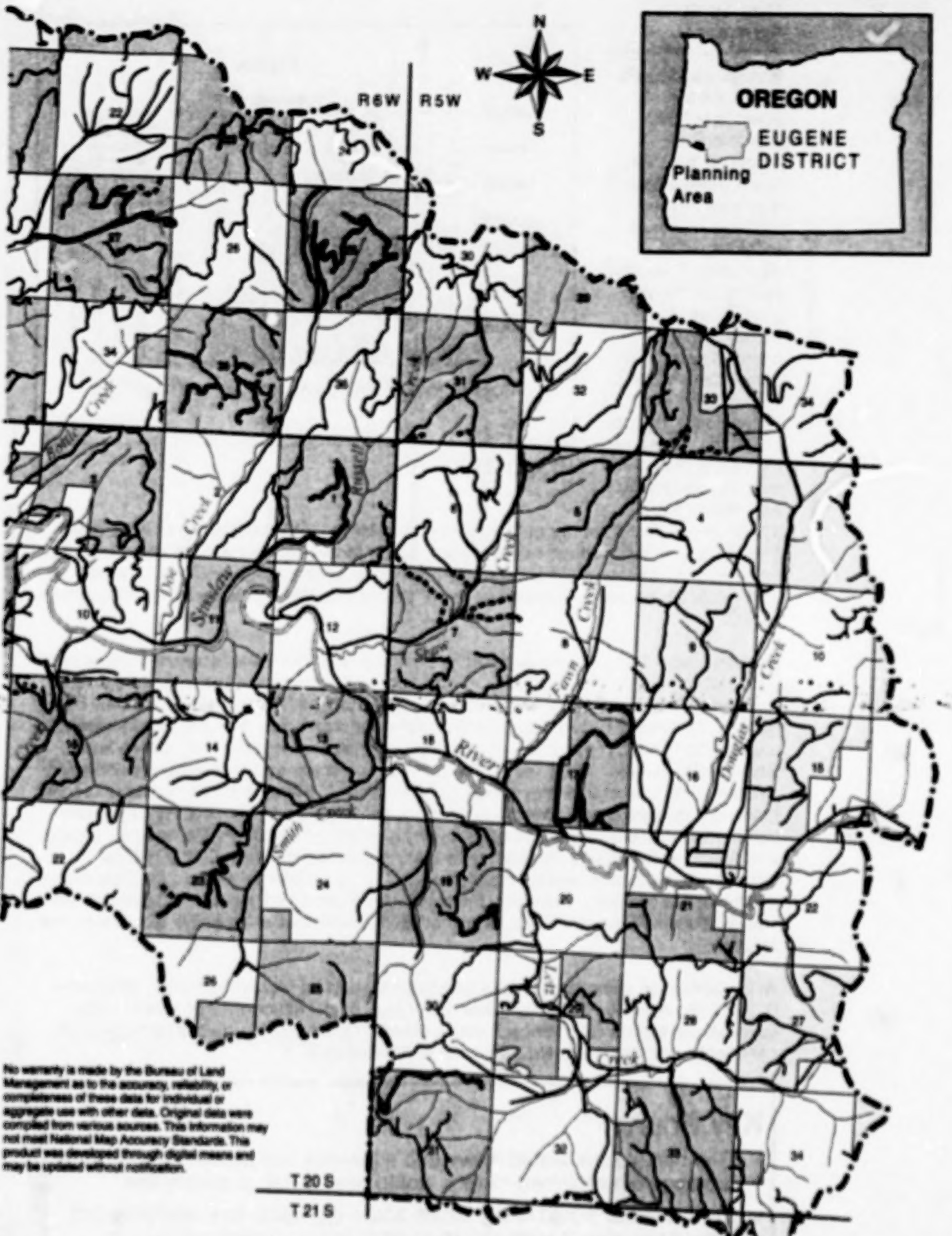
- Road to be Decommissioned
- Road Passively Decommissioned
- Other Road
- Siuslaw River
- Stream
- Planning Area Boundary

BLM Administered Land

- ▨ Late-Successional Reserve
- ▨ Other
- ☐ Non-Federal Land

*Note: Alternative F is identical to Map 3: Alternative C*

# Map 6: Alternative F - Road Decommissioning



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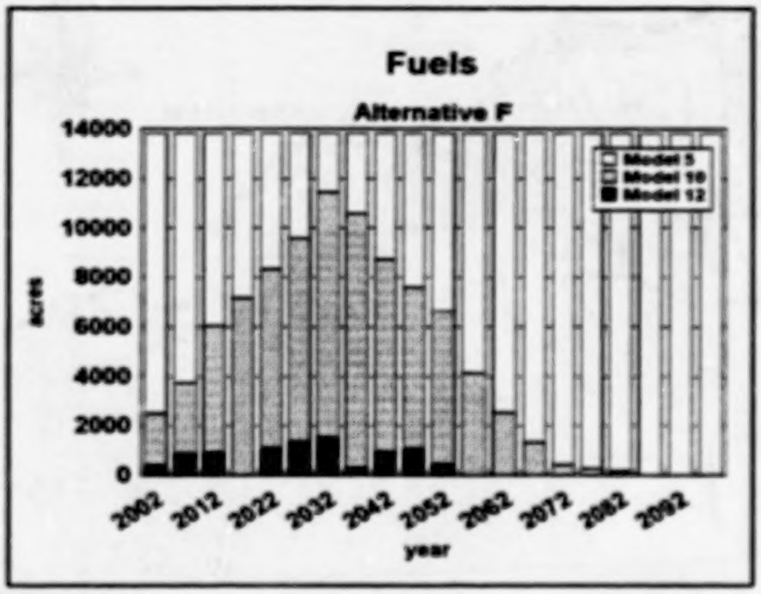
## ISSUE 3: *What level of risk to existing late-successional forest would result from restoration activities?*



Graph 33.

**Fire:** Similar to Alternative C, thinning in Alternative F would periodically create a small acreage (<2,000 acres) in Fuel Model 12, but these acres would quickly decrease as the slash decomposes (see Graph 33). Alternative F would periodically create more acres in Model 12 in future decades as a result of repeated thinning. The analysis may overstate the amount of fuel that would be created by the future thinning, which may not result in Model 12 fuel levels (and a shorter subsequent time in Model 10). The thinning in Alternative F would only slightly reduce the future acreage in Model 10, compared to Alternative A, but repeated thinning would shorten the time that a large acreage would be in Model 10. This would still present a substantial risk of severe fire, although less so than Alternatives A or C.

**Bark Beetles:** At the individual stand scale, there would be some increased risk of bark beetle damage under Alternative F. Approximately 1,900 acres of young stands would experience tree mortality, with a total of approximately 1,900-11,600 trees killed by bark beetles. This relatively low intensity of mortality (approximately 1-6 TPA) would have little effect of stand structure, but would contribute to snag and coarse woody debris levels. Some additional bark beetle mortality would occur if snags and coarse woody debris are created at the time of thinning, similar to Alternative C. If snag and coarse woody debris creation is delayed, any additional effect may be moderated by adaptive management: tree mortality caused by bark beetles following thinning may obviate the need for snag and coarse woody debris creation, similar to Alternatives B, D, and E. If a natural disturbance, such as a severe windstorm, were to occur, bark beetles would likely cause additional tree mortality. However, the thinning in Alternative F would create stands that would be relatively stable, which would reduce the likelihood of extensive blowdown (see Issue 4).

At the landscape scale, bark beetle populations would be slightly lower than Alternative B, and there would be a slightly lower risk of bark beetle attack on large trees in late-successional stands near thinned, young stands. Otherwise, effects of Alternative F on bark beetle populations would be similar to Alternative B.

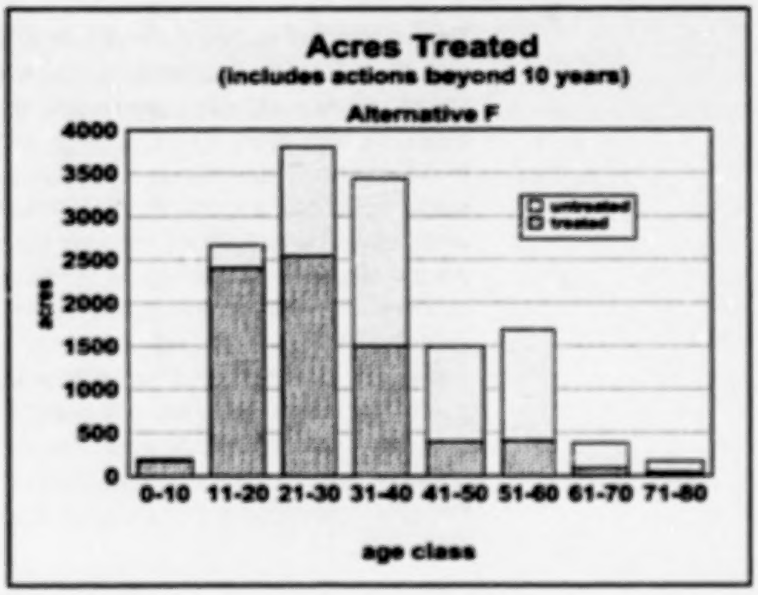
### KEY POINTS

- Thinned stands would move into a low-risk fuel model, but the large acreage of unthinned stands would pose a risk of severe fire.
- Bark beetles would likely cause some individual tree mortality, but would not pose a high risk to existing late-successional forests.

## ISSUE 4: *How would thinning affect development of late-successional forest structural characteristics?*

Under Alternative F, approximately 6,300 acres of the 13,800 acres of young stands would receive no treatment and would continue on their existing developmental pathway (see Graph 34). These untreated stands would develop as described under Alternative A.

Alternative F would thin approximately 6,100 acres during the 10-year span of the proposed plan. It is reasonably foreseeable that under the management approach of Alternative F, most of these acres would receive additional thinning beyond the 10-year span of the proposed plan, and 1,400 additional acres would be thinned.



**Graph 34.**

Within the 100-year analysis period, approximately 1,000 acres of stands currently 80 years old would develop late-successional structure. Alternative F would have limited effectiveness at speeding the development of late-successional structure. The repeated thinning from below would maintain or increase the vigor of the residual trees, increasing the mean diameter and canopies of the residual trees within the stand (see Figure 45). However, the growth of the shade-tolerant understory would be inhibited by the maintenance of high levels of canopy closure. The repeated thinning from below would continually reduce the range of tree diameters.

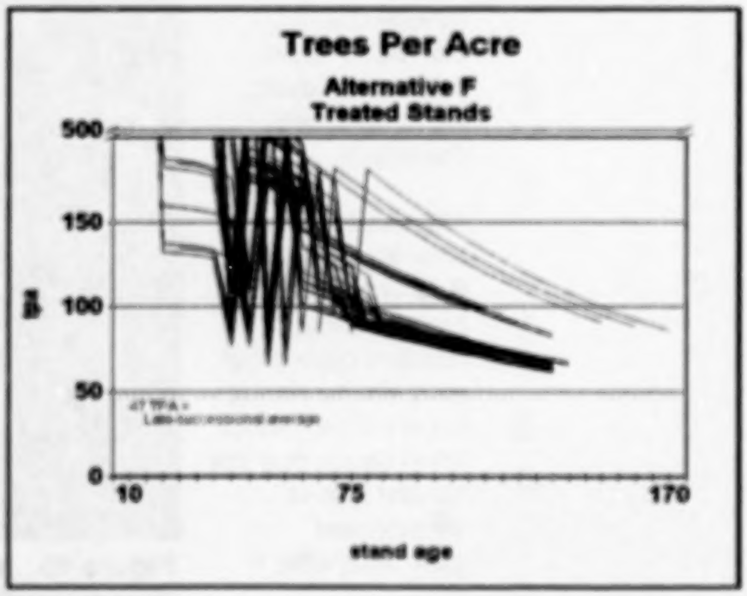
**Figure 45.** *Repeated thinning in Alternative F would maintain canopy closure and produce stable stands.*

Alternative F would differ from Alternative B, D, and E in that it would employ repeated commercial entry into the stands to periodically reduce stand density past the 10-year span of the proposed plan. Alternative F would employ relatively light thinning prescriptions (see Table 7), designed to maintain 40% canopy cover and thereby reduce any short-term impacts to northern spotted owl dispersal habitat (see Issue 6). Most of the cut trees would be removed, which would mitigate fuel loadings and bark beetle impacts. Thinning would increase individual tree growth rates and thereby increase stand mean tree diameters. These thinning prescriptions would reduce the range of tree diameters by thinning from below, which would preferentially cut the smaller trees, similar to Alternatives B and C.

Development of understory shade-tolerant conifers would be inhibited by the high overstory densities necessary to maintain 40% canopy closure. In most prescriptions, stands would eventually become strongly two-tiered, with a moderately dense Douglas-fir overstory high above a slow-growing understory of shade-tolerant conifers. In contrast to Alternative C (and stands >30 years old in Alternative B), where reclosure of the stand would cause mortality of the shade-tolerant understory, the repeated thinning in Alternative F would allow continued survival of understory trees. Stands would likely have a relatively static structure at the end of the 100-year analytical period, similar to many of the moderately dense mature stands in the planning area. Some natural disturbance would be needed to remove enough of the overstory Douglas-fir trees to accelerate growth of the shade-tolerant understory. It is reasonably foreseeable that patch cuts may be included in subsequent thinning beyond the 10-year span of the proposed plan. Patch cuts would reduce overstory density sufficiently to accelerate understory growth in the immediate location of the patch cuts, which would improve the overall development of shade-tolerant understories and spread the range of tree diameters.

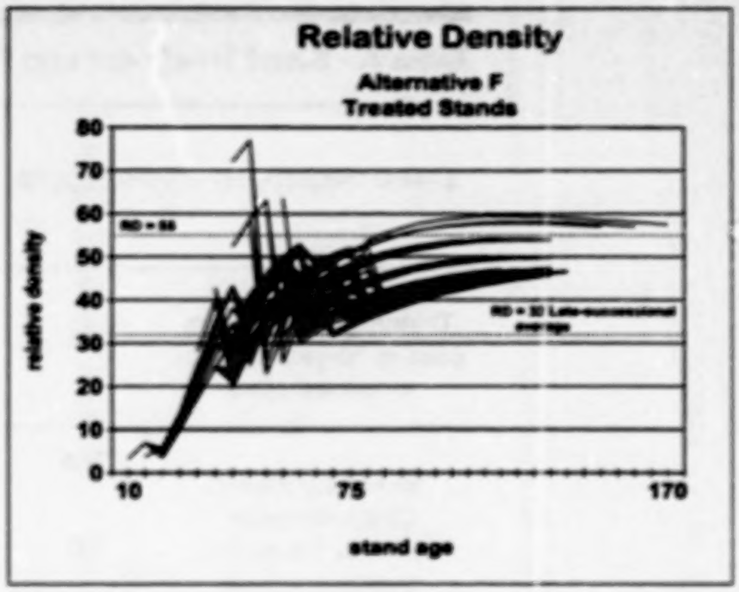
Stands <21 years of age would be pre-commercially thinned to 135-250 TPA. Trees 2"-8" dbh would be cut. At the end of the 100-year analytical period, these stands would have 75-110 TPA, of which 40-50 would be overstory Douglas-fir, with relative densities of 42-53, just below the point at which density-dependent mortality would occur (see Graphs 35 and 36). Overstory trees would have moderate crowns, and canopy cover would be high (50 - 75%). These stands would develop height:diameter ratios between 60-65, which would be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 37).

Stands 21-40 years of age would be thinned with a variety of treatments: the younger stands in the age class would be pre-commercially thinned to 105-250 TPA. The older stands in the age class would be commercially thinned from below to 60-35 TPA. Trees 4"-18" dbh would be cut. Thinning of these stands would sometimes include removal of cut trees, depending upon the size of trees cut and whether removal would be necessary to reduce fuel and bark beetle risk. At the end of the 100-year analytical period, these stands would have 65-100

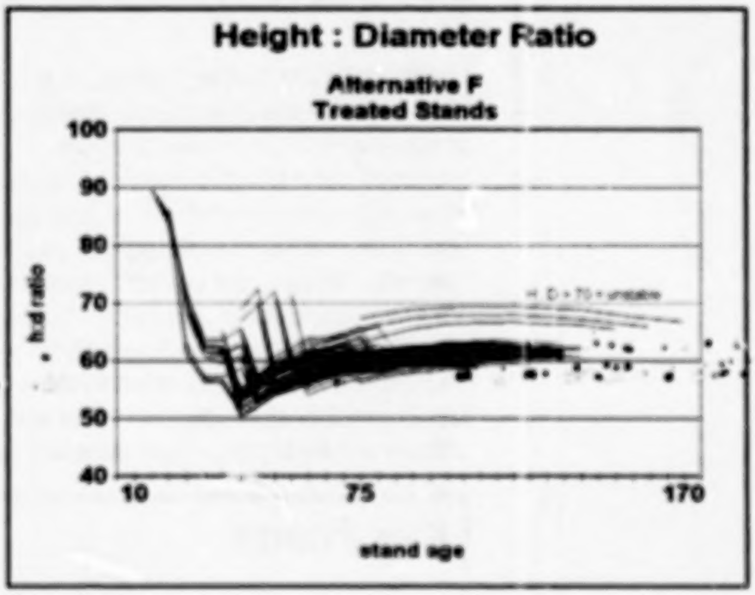


Graph 35

TPA, of which 35-45 would be Douglas-fir overstory trees, with relative densities of 45-55, just at or below the point at which density-dependent mortality would occur (see Graphs 35 and 36). For example, Figures 46 and 47 illustrate the development of the 30-year-old stand, showing the first thinning treatment in 2012, and the moderately dense overstory and limited development of the shade-tolerant understory in 2097. These stands would develop height: diameter ratios between 60-65, which would be stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 37).



Graph 36.



Graph 37.

Stands 41-80 years of age would be thinned from below to 55-105 TPA. Trees 4"-20" dbh would be cut. Thinning would generally include removal of cut trees to reduce fuel and bark beetle risk. At the end of the 100-year analytical period, these stands would have 70-100 TPA, of which 35-45 would be Douglas-fir overstory trees, with relative densities of 45-58, just at or below the point at which density-dependent mortality would occur (see Graphs 35 and 36). These stands would develop height:diameter ratios between 60-70, which would generally be stable, but the older stands would develop height:diameter ratios between 65-70, which may be less stable (Lohmander and Helles 1987; Wilson and Oliver 2000) (see Graph 37).

**Table 7. - Stand Treatment and Results Summary - Alternative F**

| STAND TREATMENT AND RESULTS | | STAND AGE | | |
|---|---|---|---|---|
| | | <21 | 21-40 | 51-80 |
| **Thinning prescription (during 10-year span of proposed plan)** | **TPA*** | 135-250 | 105-250<br>60-135 | 55-105 |
| **Resulting Stand Characteristics (end of 100-year analysis period)** | **TPA** | 75-110 | 65-100 | 70-100 |
| | **RD** | 42-53 | 45-55 | 45-58 |
| | **H:D** | 60-65 | 60-65 | 60-70 |

*Uplands and 100-foot riparian areas would receive same treatments

In summary, Alternative F would treat a moderate portion of the young stands in the planning area, and the thinning prescriptions would slightly speed the development of late-successional forest structure. The thinning prescriptions would create stable stands of trees with a moderately large-diameter Douglas-fir overstory, high above a small, slow-growing understory, with considerable separation between overstory and understory canopies (although future patch cuts may accelerate understory growth in patches). Despite the variety of thinning prescriptions, most stands would develop similar structure, particularly with regard to understory development (see Table 7 and Figures 48 to 55). The thinning in Alternative F would prevent the extensive density-dependent mortality and stand stagnation that would occur in Alternative A. However, creation of late-successional structure in these stands would require some natural disturbance or additional thinning to reduce overstory density and thereby increase understory growth.

## KEY POINTS

- 6,100 (44%) of stands  80 years old would be treated over 10 years.
- 1,000 acres would develop late-successional structure.
- Thinning would have limited effectiveness in creating late-successional structure, but stands would be stable.

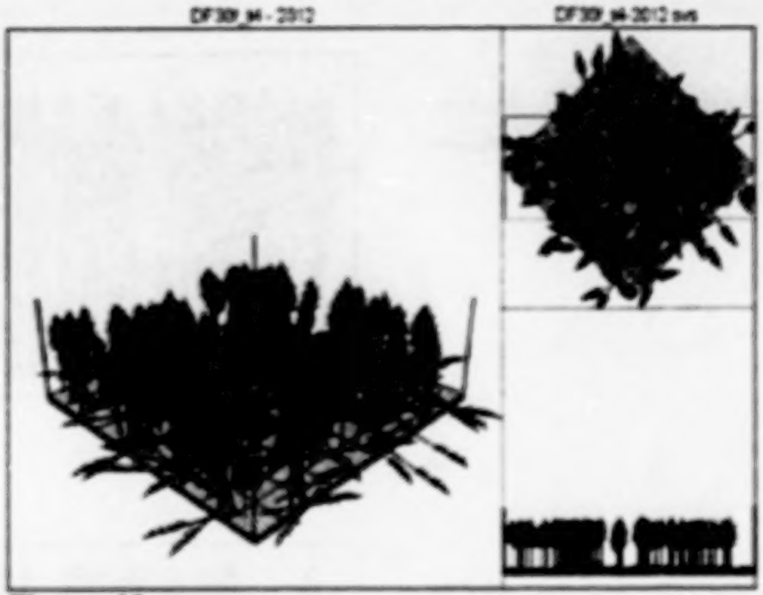


**Figure 46.** *Thinning of the 30-year-old Type Stand*

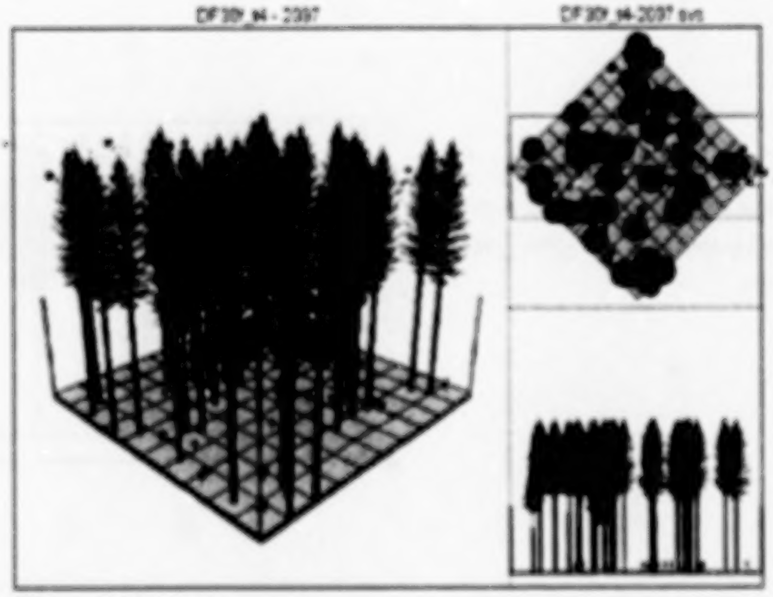


**Figure 47.** *Development of the 30-year-old Type Stand*

**Figure 48**
*Untreated stands would develop a high-density, uniform condition, with no understory of shade-tolerant conifers.*

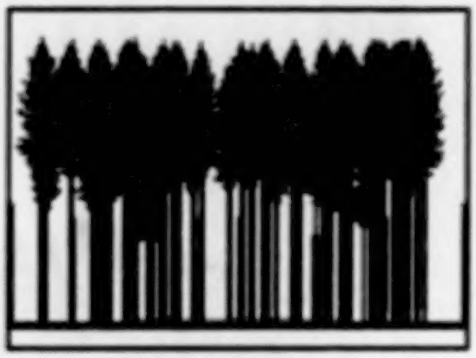


**Figure 49**
*Treatment 1 (1st thin-102 TPA; 2nd thin-70 TPA; 3rd thin-45 TPA) would create a moderate-density overstory of Douglas-fir, with small, slow-growing shade-tolerant conifers.*

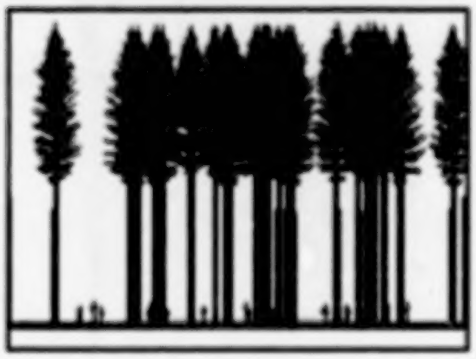


**Figure 50**
*Treatment 2 (1st thin-102 TPA; 2nd thin-50 TPA; 3rd thin-45 TPA) would create a moderate-density overstory of Douglas-fir, with small, slow-growing shade-tolerant conifers.*

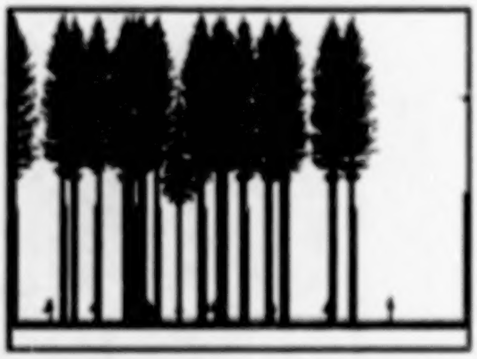


**Figure 51**
*Treatment 3 (1st thin-110 TPA; 2nd thin-85 TPA; 3rd thin-45 TPA) would create a moderate-density overstory of Douglas-fir, with small, slow-growing shade-tolerant conifers. (Note that the few, larger shade-tolerant conifers are part of the original cohort).*

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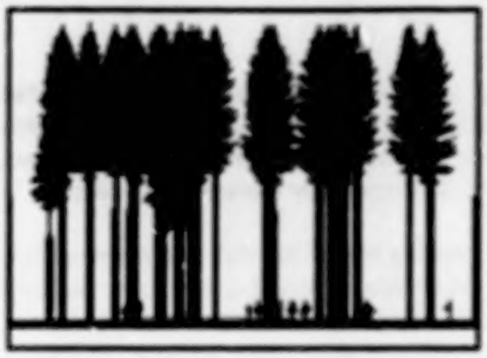


**Figure 52**
*Treatment 4 (1st thin-110 TPA; 2nd thin-60 TPA; 3rd thin-45 TPA) would create a moderate-density overstory of Douglas-fir, with small, slow-growing shade-tolerant conifers.*

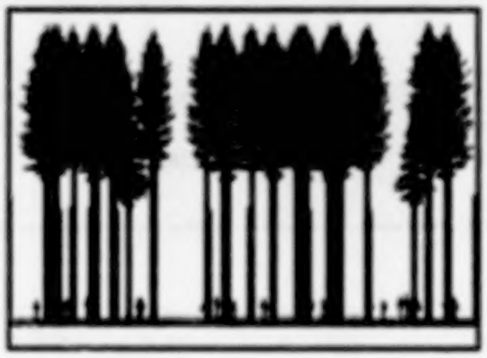


**Figure 53**
*Treatment 5 (1st thin-70 TPA; 2nd thin-50 TPA) would create a moderate-density overstory of Douglas-fir, with small, slow-growing shade-tolerant conifers.*

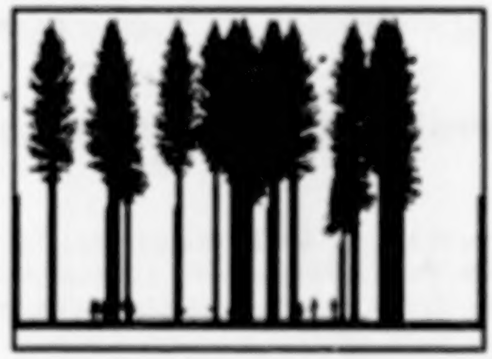


**Figure 54**
*Treatment 6 (1st thin-80 TPA; 2nd thin-65 TPA; 3rd thin-45 TPA) would create a moderate-density overstory of Douglas-fir, with small, slow-growing shade-tolerant conifers. (Note that the few, larger shade-tolerant conifers are part of the original cohort).*

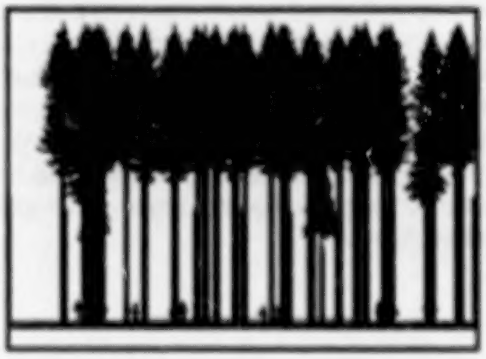


**Figure 55**
*Treatment 7 (1st thin-100 TPA; 2nd thin-60 TPA) would create a moderate-density overstory of Douglas-fir, with small, slow-growing shade-tolerant conifers. (Note that the few, larger shade-tolerant conifers are part of the original cohort).*

## ISSUE 5: *What are the effects of restoration activities on marbled murrelet habitat?*

Alternative F would thin stands ≤80 years old, but would avoid adverse effects to marbled murrelets by evaluated stands 51-80 years old prior to thinning to determine if stands are potential habitat for marbled murrelets. Stands that are potential habitat would be thinned only if surveys find the stands to be unoccupied by marbled murrelets.

Under Alternative F, stands would develop trees ≥32" dbh at approximately the same rate as in Alternative A. However, Alternative F would speed the development of large branches. In 50 years, 5,200 acres would have at least one tree per acre with at least one branch 5" in diameter, five times the amount in Alternative A. In Alternative F, nearly all of the stands currently ≤80 years old would have at least one tree per acre with at least one branch 5" in diameter within the100-year analysis period (13,600 acres or 98%). The maximum branch size in Alternative F would be larger than in Alternative A for all age classes, depending on the treatment prescriptions (1/2" - 1" larger at the end of the 100-year analysis period).

Under Alternative F, 200 acres (1% of stands currently  80 years old) would achieve target habitat conditions within the 100-year analysis period. Very few stands would develop a wide enough range of tree diameters under Alternative F to meet the criteria for target habitat conditions.

### KEY POINTS

- All stands would have trees  32" dbh, and almost all would develop branches 5" and larger within 100 years.
- 200 acres of young stands would achieve target habitat conditions within 100 years.

## ISSUE 6: *What are the effects of restoration activities on northern spotted owl habitat?*

Development of dispersal habitat under Alternative F would be largely indistinguishable from Alternative A. All thinning prescriptions in Alternative F would maintain dispersal habitat, because thinned stands would retain more than 40% canopy closure. Although thinning might temporarily decrease habitat quality (see Anthony et al. 2001, which found that owls avoided recently thinned stands within their home range), the thinned stands would continue to meet the definition of dispersal habitat. Because Alternative F would thin stands repeatedly, current owl pairs might be adversely affected if they avoid recently thinned stands, even though thinned stands would continue to meet the definition of dispersal habitat. However, it is uncertain whether owls would always avoid recently thinned stands or how long owls would avoid recently thinned stands. Under Alternative F, most of the stands currently ≤80 years old (13,600 or 98%) would become dispersal habitat in 35 years, and all stands would become dispersal habitat in 40 years. Alternative F may affect critical habitat by degrading existing dispersal habitat, but would not downgrade (i.e., altering the stand conditions below the threshold conditions for dispersal habitat) any existing dispersal habitat.

Under Alternative F, 3,800 acres (28% of stands currently ≤80 years old) would become suitable habitat by the end of the 100-year analysis period. A small acreage – 1,000 acres (7%) – would achieve target habitat conditions by the end of the 100-year analysis period.

## KEY POINTS

- All young stands would develop into dispersal habitat similar to Alternative A.
- 3,800 acres would develop into suitable habitat within 100 years.
- 1,000 acres would achieve target habitat conditions within 100 years.

## ISSUE 7: *What are the effects of restoration activities on coho salmon habitat?*

**In-stream structure:** Alternative F would have effects on in-stream structure similar to Alternative C, except that Alternative F would not fall or pull over trees in addition to constructed structures. Alternative F would create stable structures and meet the ODFW riparian habitat benchmark on 3.8 miles of $3^{rd}$-$5^{th}$-order streams, but would not create woody debris on other streams (see Figure 56).

**Figure 56.** *Although Alternative F would create in-stream structures in larger streams, it would not create woody debris in small streams.*

**Riparian stands:** Alternative F would thin 1,500 acres (44%) of riparian areas (<100 feet from streams) over the10-year span of the proposed plan, and a total of 1,900 acres (55%) of riparian areas including probable treatments beyond 10 years. Alternative F would have effects on the development of riparian trees big enough to provide key pieces of woody debris (≥24" dbh) similar to all alternatives (See Alternative A, Issue 7). However, it would take considerably longer to develop very large trees that would provide more stable key pieces of woody debris (≥32" dbh): at the end of the 100-year analysis period, approximately 2,700 acres out of 3,400 riparian acres (80%) would have developed sufficient density of trees ≥32" dbh. Alternative F is slower than all other alternatives except Alternatives A and C to develop sufficient density of these larger trees, primarily because it treats fewer riparian acres than all other alternatives except Alternatives A and C.

**Sedimentation:** Alternative F would have effects on sedimentation from existing roads, road decommissioning, and culvert replacement and removal similar to Alternative B.

Alternative F includes approximately 11.5 miles of new road construction, which would be decommissioned after a single logging season. The new road construction may include approximately 6 temporary stream crossings over the 10-year span of the proposed plan, which would cause temporary pulses of approximately 0.6 cubic yards of sediment/year of sedimentation over 10 years from culvert placement and removal.

Construction of in-stream structures in Alternative F would have effects similar to Alternative C.

**Barriers:** Alternative F would have effects on fish-barrier culverts and make additional habitat available similar to all action alternatives (See Alternative B, Issue 7).

## KEY POINTS

- Stable in-stream structure would be created on 0 miles 1st-2nd-order streams, and 3.8 miles of 3rd-5th-order streams in 10 years.
- 80% of young riparian forests would develop sufficient density of very large (≥32" dbh) conifers in 100 years.
- Existing road-related sedimentation would be reduced to 74.0 cubic yards/year. Restoration actions and associated road construction would cause a total of 10.6 cubic yards of sediment/year.
- Removal of 10 barrier culverts would open 7.0 miles of new coho salmon habitat.

## ISSUE 8: *How would restoration activities affect the presence and spread of noxious weeds?*

Alternative F would result in some disturbance to both soils and existing vegetation from forest management and aquatic restoration activities in stands ≤80 years old, which could potentially result in further establishment and spread of noxious weeds in treated stands within the planning area.

The decommissioning of 24 miles of road would reduce the vectors for the introduction, establishment, and spread of noxious weeds within the planning area, but would be partially offset by the construction of 11.5 miles of new road. However, new road construction would be temporary and would provide vectors for the spread of noxious weeds only until the temporary roads are decommissioned.

Effects on noxious weeds on roads that are not decommissioned would be the same as in Alternative A.

### KEY POINTS

- Decommissioning 24 miles of road would be partially offset by construction of 11.5 miles of new roads and would only slightly reduce noxious weed establishment and spread.

## ISSUE 9: *What would be the economic effects of restoration activities?*

Under Alternative F, 6,100 acres would be treated with non-commercial silvicultural treatments, which would generate 350 months of contract work over the 10-year span of the proposed plan. There would be 20 months of work for silvicultural treatments for each of the first three years of implementation, 50 months of work for each of the second three years, and 35 months of work for each of the final four years.

Decommissioning 24 miles of road would generate 10 months of contract work, the same as in Alternative C.

Replacing 10 culverts would generate 11 months of contract work, the same as in all action alternatives.

In-stream restoration would generate 12 months of contract work, the same as in Alternatives C and D.

There would be approximately 3,400 acres of commercial thinning timber sales within the 10-year period, which would generate $12.7 million in revenues. Alternative F would have opportunities for revenue for commercial thinning beyond the 10-year span of the proposed plan.

### KEY POINTS

- 383 months of contract work over 10 years.
- $12.7 million of revenue over 10 years.

## ISSUE 10: *What are the costs of restoration?*

For the 10-year span of the proposed plan, silvicultural treatments in Alternative F would incur $486,000 in contract costs and $4.5 million in BLM staff costs (100 work months per year, much of which would be the preparation of thinning timber sales).

Road decommissioning costs would be the same as in Alternative C. Culvert replacement costs would be the same as in all action alternatives (see Alternative B). In-stream restoration would incur $80,000 in contract costs and $40,000 in BLM staff costs.

### KEY POINTS

- $1.7 million in contracts over 10 years.
- $5.2 million in BLM staff costs over 10 years.

# COMPARISON OF THE IMPACTS OF THE ALTERNATIVES

This section compares the key points from the above analysis that relate to the three goals described in the purpose of the action.

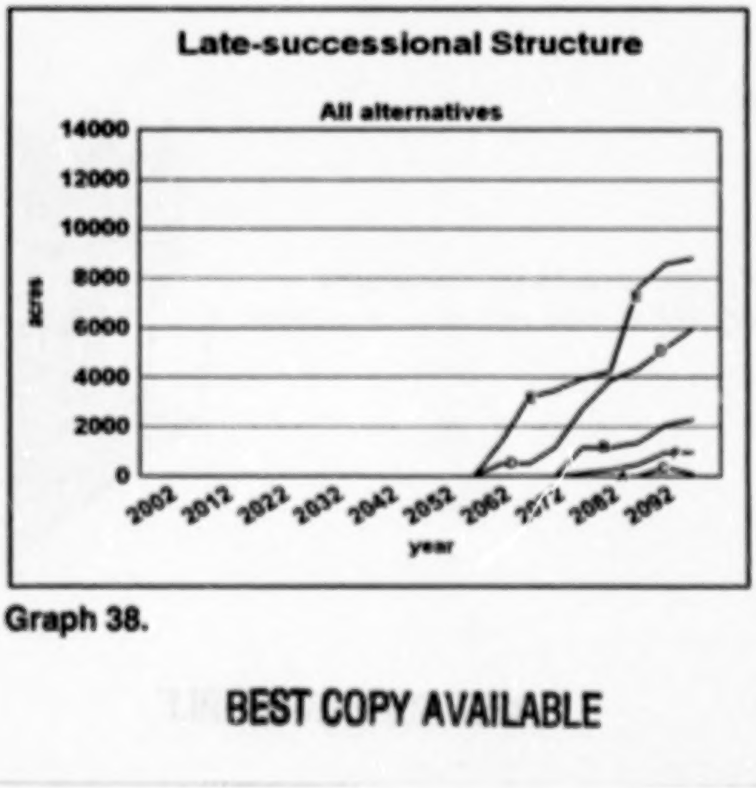
## Protect and enhance late-successional and old-growth forest ecosystems

Alternative A (No Action) would pose a high risk of catastrophic fire, because almost all stands currently ≤80 years old would go through a prolonged period of stand stagnation. Each of the action alternatives would pose a lower risk of catastrophic fire, roughly in proportion to how many acres would be thinned. Unlike attainment of late-successional structure (see below), the future fire risk appears to depend on whether stands are thinned, rather than how they are thinned.

Douglas-fir bark beetle infestations would be unlikely to cause widespread or catastrophic damage to existing late-successional stands under any of the alternatives, although there would likely be some individual tree mortality in both existing late-successional stands and stands currently ≤80 years old under all of the action alternatives, particularly alternatives B, D, and E.

## Foster the development of late-successional forest structure and composition in plantations and young forests

The alternatives vary widely in how well they would speed the development of late-successional forest structure, and Alternatives E and D would be considerably more effective than the other alternatives (see Graph 38). Figures 57 to 62 illustrate that the alternatives would result in very different stand structures, with particular difference in the development of shade-tolerant conifer understories. (Note that Alternatives D and F would apply multiple treatments in the illustrated age-class; the full range of treatments is shown in Figures 33 to 38 and Figures 48 to 55, respectively).



Graph 38.

The development of northern spotted owl and marbled murrelet suitable habitat and target habitat conditions show overall patterns similar to development of late-successional forest structure (though less clearly in murrelet suitable habitat) (see Graphs 39 to 42). However, there is some trade-off between the long-term development of late-successional

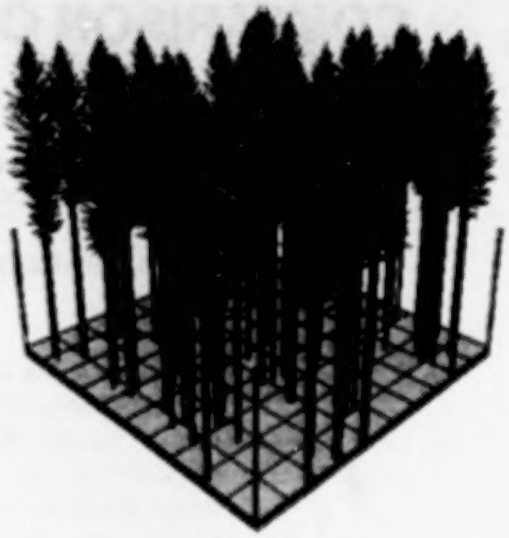


**Figure 57**
*Under Alternative A (No Action), the stand would have a high-density, uniform condition with no understory of shade-tolerant conifers.*

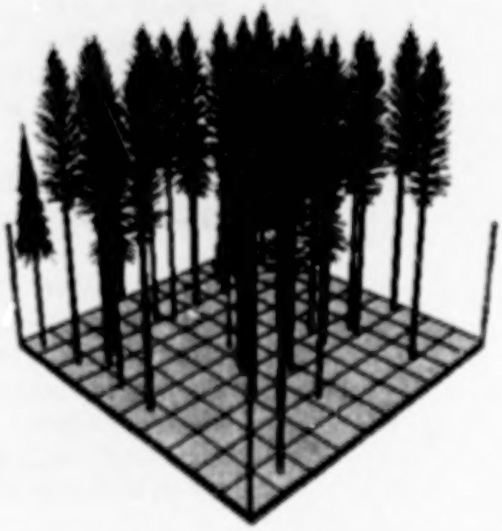


**Figure 58**
*Under Alternative B, the stand would have a moderately open overstory with moderate development of shade-tolerant conifers.*

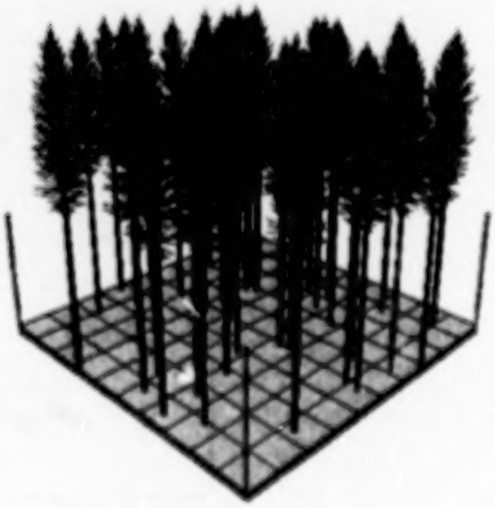


**Figure 59**
*Under Alternative C, the stand would have a moderately dense, uniform overstory with no understory of shade-tolerant conifers.*

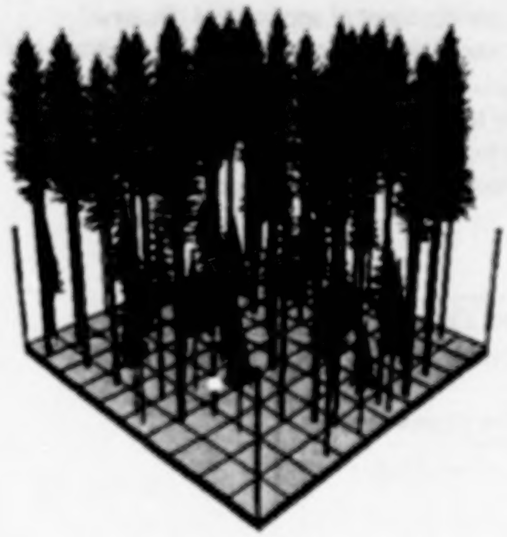


**Figure 60**
*Under Alternative D, the stand would have a moderately open overstory with good development of shade-tolerant conifers in the understory (see Figures 33 to 38 for the full range of treatments).*

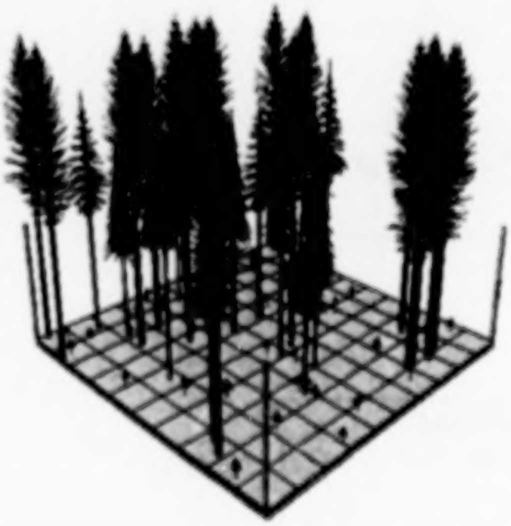


**Figure 61**
*Under Alternative E, the stand would have an open overstory with abundant large shade-tolerant conifers, and scattered smaller shade-tolerant conifers.*

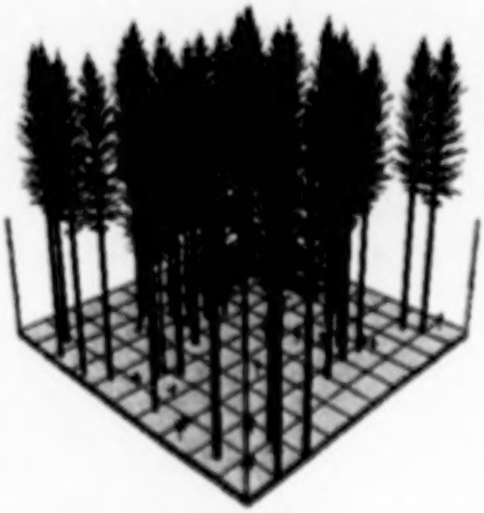


**Figure 62**
*Under Alternative F, the stand would have a moderately dense, uniform overstory with small slow-growing shade-tolerant conifers in the understory (see Figures 49 to 55 for the full range of treatments).*

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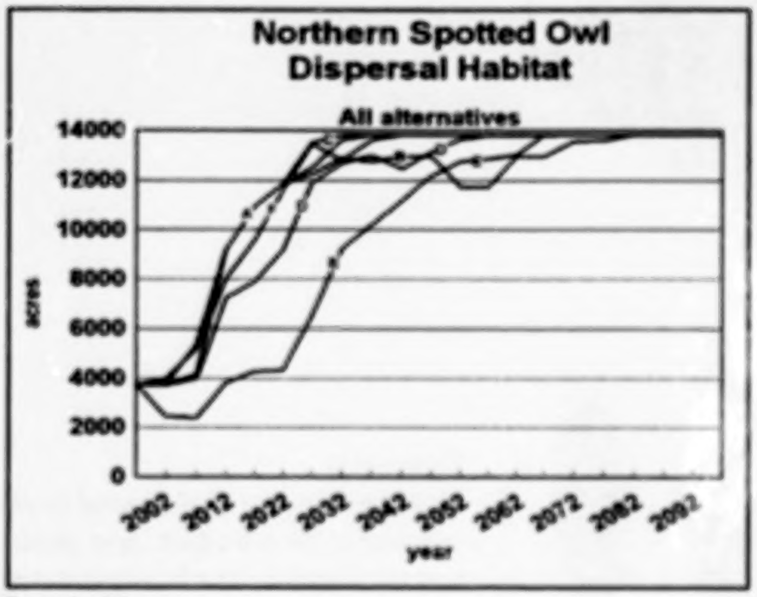
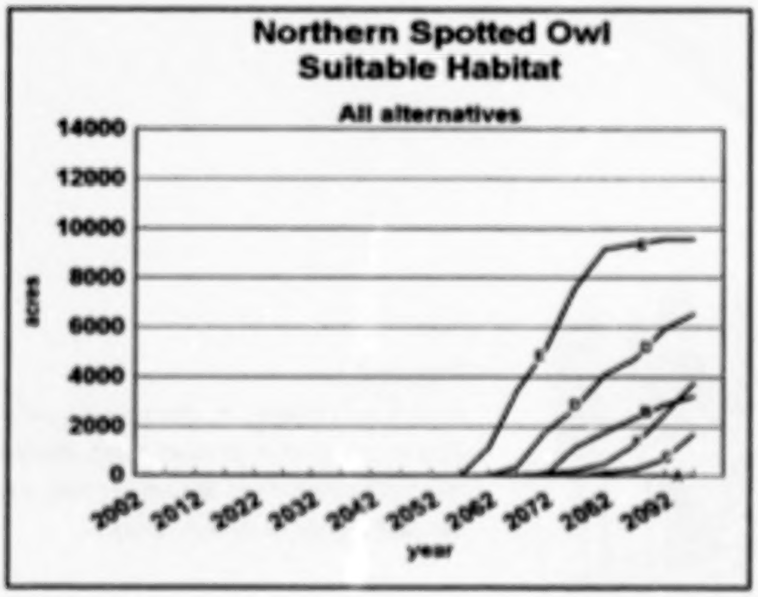
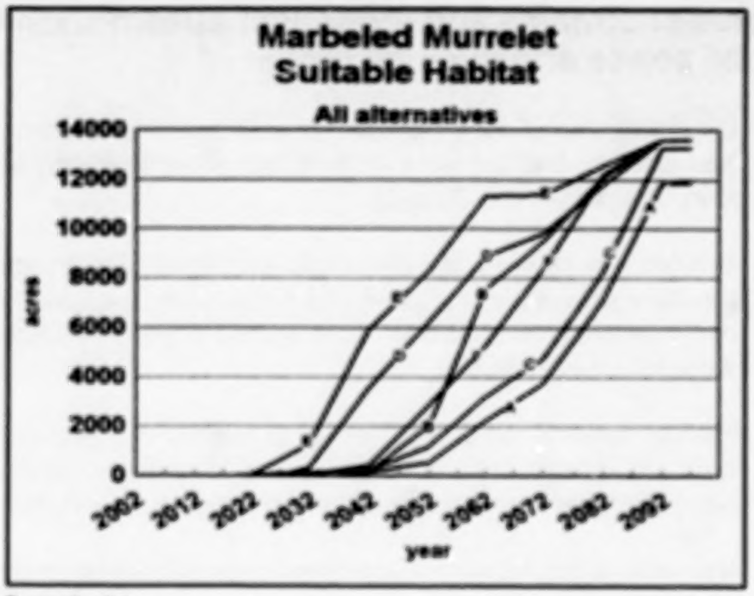
structure (see Graph 38) and the short-term development of spotted owl dispersal habitat (see Graph 39). Alternative E, which would be the most effective at speeding the development of late-successional structure, would provide the least spotted owl dispersal habitat in the short-term and even temporarily reduce it from the current amount. Alternatives A, C, and F, which would maximize the development of dispersal habitat, would be largely ineffective at speeding the development of late-successional structure.



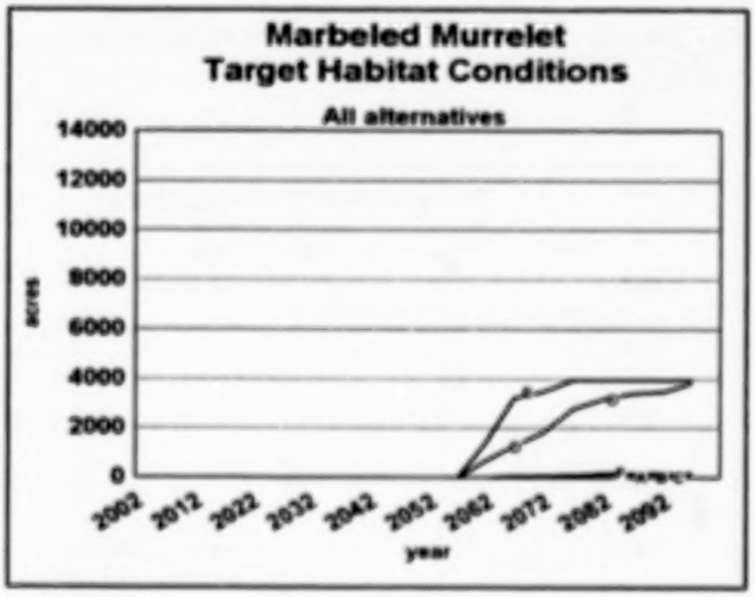
Graph 39.



Graph 40.



Graph 41.



Graph 42.

## Reconnect streams and reconnect stream channels to their riparian zones and upslope areas

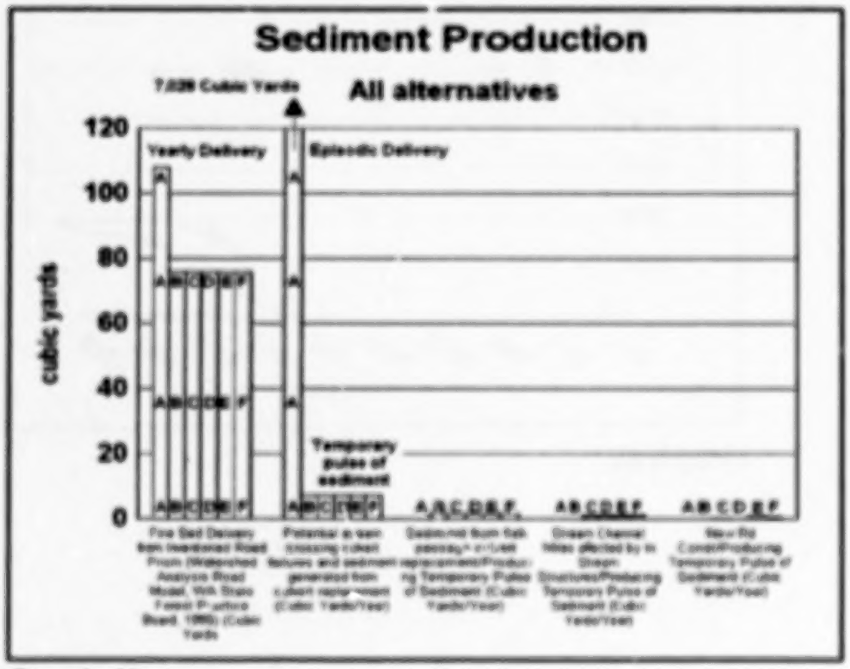
The action alternatives would have generally similar effects on coho salmon habitat in most respects, but Alternative A (No Action) would be sharply different from each of the action alternatives (see Table 8).

All action alternatives would create additional woody debris in streams, though Alternative D would create stable structure on the most stream miles; Alternative B would be ineffective in creating stable structure in larger streams; and Alternative F would not add debris to smaller streams.

Riparian stands would develop very large conifers roughly in proportion to the amount of the riparian area than would be thinned, but the difference among alternatives is much less distinct than for the attainment of late-successional structure in upland stands.

Alternative A (No Action) would continue to produce the most chronic sedimentation to streams and would pose a high risk of catastrophic sedimentation from culvert failures (see Graph 43). All of the action alternatives would result in an overall reduction sedimentation to a similar extent, despite differences in the design features related to in-stream restoration, road construction, and road decommissioning (see Graph 44).

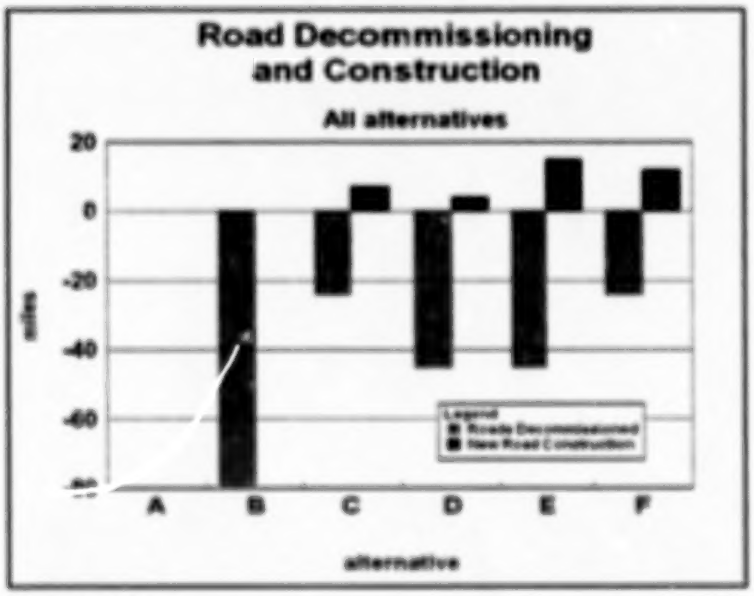
All of the action alternatives would remove fish-barrier culverts and open additional habitat.



**Graph 43.**

## Table 8. Summary of effects on coho salmon habitat

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| **Stable structure created on 1st-2nd-order streams (miles)** | 0 | 105.7 | 35.9 | 199.5 | 199.5 | 0 |
| **Stable structure created on 3rd-5th-order streams (miles)** | 0 | 0 | 3.8 | 8.2 | 5.8 | 3.8 |
| **Riparian stands with very large conifers (≥13 TPA ≥32" dbh) at the end of 100-year analysis period (acres)** | 2,500 | 2,900 | 2,500 | 3,100 | 3,300 | 2,700 |
| **Total chronic sedimentation (cubic yards/year) (including all restoration actions, but excluding episodic delivery)** | 108.0 | 83.0 | 84.4 | 84.0 | 84.8 | 84.6 |
| **Additional fish habitat (stream miles)** | 0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |



Graph 44.

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# CHAPTER 5

# Consultation and Coordination

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# SCOPING

In July 2000, we distributed preliminary information on LSR 267 restoration at local community functions. At the same time, we also mailed this information to over 200 persons or groups known to have interest in the local area. The purpose was to initiate issue identification and to open public dialogue regarding the proposed restoration plan. During 2001, BLM solicited public participation through a series of public meetings and field trips:

| | |
|---|---|
| February 28, 2001 | Public Meeting, Eugene BLM Office, Eugene, OR |
| March 23, 2001 | Public Meeting, Lorane Grange, Lorane, OR |
| April 19, 2001 | Presentation, Coast Provincial Advisory Council |
| May 19, 2001 | Field Trip, Siuslaw River area |
| May 31, 2001 | Field Trip, Perkins Creek area |
| June 14, 2001 | Field Trip, Swing Log Creek area |
| July 12, 2001 | Field Trip, Haight Creek area |
| July 21, 2001 | Field Trip, Creat Road area |
| September 13, 2001 | Public Meeting, Eugene BLM Office |
| October 25, 2001 | Presentation, Coast Provincial Advisory Council |
| November 15, 2001 | Field Trip, Monte Carlo Test Plots |
| March 12, 2002 | Presentation, ONRC Action Team |

In addition, BLM received six letters or e-mails in which the authors expressed concerns or made suggestions related to LSR restoration. BLM issued four newsletters about LSR restoration and this proposed plan announcing field trips or public meetings, addressing questions from the public, and describing preliminary issues and alternatives.

BLM published a Notice of Intent to prepare an EIS in the Federal Register on October 9, 2002, beginning the formal scoping period. The Notice of Intent requested comments on the scope of the analysis for this proposed plan. BLM mailed a letter and a copy of the Notice of Intent to each person and group on the LSR 267 mailing list. The letter explained that comments received prior to the formal scoping period would be used in conjunction with those received during formal scoping, and commentors did not need to restate their concerns during formal scoping to have them considered in the EIS. In response to the Notice of Intent, BLM received one letter from the Oregon Natural Resources Council (ONRC). Their comments were not specific to this EIS and did not substantively add to previous comments received from ONRC during informal scoping.

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# SUMMARY OF SCOPING COMMENTS

During field trips and public meetings, or through written correspondence, BLM received many comments on the scope of the environmental analysis, possible alternatives, and issues for consideration. These comments, and how this draft EIS responds to them, are summarized below:

## Commercial Timber Harvest

Several commentors expressed concern that BLM should not use commercial timber harvest to achieve restoration projects. Commentors felt that "logging incentives" should be removed from restoration activities. Other commentors were concerned that a commercially viable product would be forgone unnecessarily. The range of alternatives in this draft EIS responds to these concerns: Alternative B would conduct restoration without commercial removal of cut trees, and other alternatives would have different levels of commercial timber harvest.

## Risk of Fire and Bark Beetle Infestation

Commentors were concerned that leaving cut trees in thinned stands would increase the risk of fire and insect infestations. Issue 3 explicitly addresses this concern; it compares the risk of fire and insect infestation among all alternatives.

## Short-term Impacts vs. Long-term Benefits

Many commentors felt BLM should address the trade-offs between short-term effects and long-term benefits to critical resources. Issues 6 and 7 address this concern. Issue 6 considers the effects of the alternatives on existing levels of northern spotted owl dispersal habitat and anticipated development of suitable owl habitat and target habitat conditions. Similarly for aquatic habitat, Issue 7 compares the short-term effects of restoration activities on sedimentation compared to long-term benefits to coho salmon habitat.

## Need for New Roads

Several commentors stated that BLM should not construct any more roads. Others were concerned about the effects of road closures on public access. The alternatives and several issues address these concerns. Each alternative would have different levels of new road construction, ranging from none (Alternatives A and B) to 15 miles (Alternative E). The alternatives would also decommission different lengths of existing road. Issue 1 addresses effects to road decommissioning and public access; Issue 2 addresses new road construction.

## Multiple Silvicultural Trajectories

A number of commentors expressed the opinion that there were many pathways for the development of late-successional forest structure, and that BLM should take this into account in developing a restoration program. The range of alternatives presented in this draft EIS compare a variety of different silvicultural trajectories. Only one alternative – Alternative A (No Action) – represents a single trajectory.

## Maintaining Management Options

Commentors suggested that an alternative be considered that maintains future management options, in part to preserve opportunities for adaptive management. All alternatives leave a substantial amount of forest untreated. If future management were to focus on different goals, a substantial land base would remain available under all alternatives.

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### Restore Natural Processes and Let the Disturbances Happen

One commentor suggested that BLM restore natural processes and let natural disturbances occur. To some extent, Alternatives A and E address this comment. Alternative A (No Action) would do no active management of stands and streams and let current conditions continue. Alternative E would attempt to restore stand densities to within the natural range of variability as quickly as possible. However, an alternative that would do no active management and would let all disturbances happen (i.e., without wildfire suppression or salvage), is addressed in Chapter 2, as an alternative considered, but not analyzed in detail.

## CONSULTATION

BLM will consult under the Endangered Species Act with the Fish and Wildlife Service and NOAA Fisheries (National Marine Fisheries Service). BLM will likely initiate consultation following review of public comments on this draft EIS. Consultation will be completed prior to a Record of Decision on this proposed plan.

The EIS Core Team met with a group of federal scientists on April 9, 2002, to evaluate potential analysis parameters. This meeting was limited to a discussion of analytical techniques and did not include recommendations about management direction or seek consensus advice. Those present included:

| | |
|---|---|
| Eric Forsman | Wildlife Biologist, USDA Forest Service, Pacific Northwest Research Station |
| Bob Gresswell | Fisheries Biologist, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center |
| Joe Lint | Wildlife Biologist, Oregon State Office, BLM |
| Nathan Poage | Post-doctoral Research Associate, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center |
| Christian Torgersen | Fisheries Biologist, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center. |

The team later consulted further with Eric Forsman and Joe Lint in September 2002 about northern spotted owl dispersal habitat in the planning area.

The EIS Core Team consulted with Bruce Hostetler, a Forest Service entomologist at the Westside Insect & Disease Service Center, on the effects of the alternatives on Douglas-fir bark beetles. The Westside Insect & Disease Service Center provides technical assistance to federal agencies responsible for forested lands in the Pacific Northwest. For more information on the Westside Insect & Disease Service Center, see http://www.fs.fed.us/r6/nr/fid/staffweb/whowhat.shtml. The EIS Core Team met with Bruce Hostetler and Darrell Ross of Oregon State University on May 23, 2002 to evaluate Douglas-fir bark beetle risk associated with coarse woody debris creation. This meeting was limited to a discussion of environmental effects of management actions and did not include recommendations about management direction or seek consensus advice. The EIS Core Team also met with Bruce Hostetler on September 19, 2002 for further evaluation of Douglas-fir bark beetle risk associated with coarse woody debris creation.

# AVAILABILITY AND DISTRIBUTION OF THE DRAFT EIS

The draft EIS will be available on the internet at : <http://www.edo.or.blm.gov/lsr>

In addition, this draft EIS has been sent to the following agencies, organizations, and persons:

A.M. McCoy
Al Pearn
Alix and Bruce Mosieur
Anna Morrison
Barbara Beers
Bob Freimark
Bruce and Berneda McDonald
Bureau of Indian Affairs
Campbell Group, Pacific West Timberlands
Charles Hurliman
Confederated Tribes of Grand Ronde
Confederated Tribes of Coos Lower Umpqua and Siuslaw Indians
D.A. Eldridge
David Eisler
Debby Todd
Don Carlton
Douglas County Timber Operators
Environmental Protection Agency
Fabian Lawrence
First Premier Properties
George Brooks
Hampton Tree Farms
Joanne Vinton
Lane County Land Management
Linda Winter
Nancy Nichols
Oregon Department of Environmental Quality
Oregon Department of Fish & Wildlife
Oregon Department of Forestry, Western Lane
Oregon Department of Land Conservation
Oregon Natural Resources Council
Pacific Rivers Council
Paul Reed
Phil Stenbeck
R. Beers
Ron Brainard
Sierra Club - Many Rivers Group
US Fish and Wildlife Service
USFS Siuslaw National Forest
EPA Region 10- Seattle WA
Office of the Governor Attn: Natural Resource Staff
Association of O and C Counties

# LIST OF PREPARERS

The following team was primarily responsible for preparing this EIS:

**EIS Core Team**

| | | |
|---|---|---|
| Karin Baitis | Soil Scientist, BLM, 2 years;<br>Soil Scientist, private industry, 8 years | |
| | Education: | BS Geography, University of Oregon<br>MA Geography/Geomorphology, University of Oregon |
| | Expertise: | geomorphology and soils |
| | Role: | water quality, sedimentation |
| Kathy Barry | Wildlife Biologist, U.S. Fish and Wildlife Service, 22 years | |
| | Education: | BS, Wildlife Management, Humboldt State University |
| | Expertise: | endangered species biology |
| | Role: | wildlife biology and Section 7 Consultation |
| Alison Center | Wildlife Biologist, BLM, 13 years | |
| | Education: | BS, Zoology, University of Washington;<br>MS, Wildlife Biology, Washington State University |
| | Expertise: | endangered species biology |
| | Role: | wildlife biology |
| Rick Colvin | Landscape Planner, BLM, 22 years | |
| | Education: | BS, Resource Recreation Management;<br>MA, Interdisciplinary Studies, Oregon State University |
| | Expertise: | outdoor recreation planning, landscape planning, NEPA |
| | Role: | team leader, public involvement, road systems |
| Dave DeMoss | Forester, BLM, 25 years | |
| | Education: | BS, Forestry, University of California, Berkeley |
| | Expertise: | timber management, silviculture |
| | Role: | silviculture, modeling |
| Richard Hardt | Forest Ecologist, BLM, 9 years | |
| | Education: | BA, Natural Sciences, Johns Hopkins University;<br>MLA, Landscape Architecture, Harvard University;<br>PhD, Forest Resources, University of Georgia |
| | Expertise: | forest ecology, planning, NEPA |
| | Role: | forest ecology, primary author |
| Leo Poole | Fisheries Biologist, BLM, 23 years | |
| | Education: | BS, Fisheries Science, Oregon State University |
| | Expertise: | habitat management, stream restoration, salmonid husbandry |
| | Role: | riparian resources, aquatic resources |
| Mark Stephen | Forest Ecologist, BLM, 24 years | |
| | Education: | BS, Forestry, University of Kentucky |
| | Expertise: | forest resources, forest ecology, silviculture |
| | Role: | forest ecology, silviculture, noxious weeds |
| Debra Wilson | Resource Technician, BLM, 18 years | |
| | Education: | BS, Construction Management, Washington State University |
| | Expertise: | contract administration, road management, desktop publishing |
| | Role: | writer/editor, desktop publishing, road systems. |

The EIS Core Team received technical analysis from the following specialists:

| | |
|---|---|
| Darrell Ashcraft | Fuels Technician, U.S. Forest Service |
| Bruce Hostetler | Entomologist, U.S. Forest Service, Westside Insect & Disease Service Center. |

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# Glossary

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**Activity plan** - a document that describes management objectives, actions and projects to implement decisions of the RMP or other planning documents. Activity plans are usually prepared for one or more resources in a specific area.

**Adaptive management** - a continuing process of action-based planning, monitoring, researching, evaluating, and adjusting with the objective of improving implementation and achieving the goals of the selected alternative.

**Anadromous fish** - fish that are born and reared in freshwater, move to the ocean to grow and mature, and return to freshwater to reproduce, e.g. coho salmon and steelhead trout.

**Basal area** - the total cross-sectional area of all trees in a stand, measured outside the bark at breast height, usually expressed in square feet/acre or square meters/hectare.

**Best Management Practices (BMP)** - a suite of techniques that guide, or may be applied to, management actions, to aid in achieving desired outcomes. Best management practices are often developed in conjunction with land use plans, but they are not considered a land use plan decision unless the land use plan specifies that they are mandatory. They may be updated or modified without a plan amendment if they are not mandatory.

**Canopy closure** - the degree to which the canopy blocks sunlight or obscures the sky.

**Clearcut** - a timber harvest in which all or almost all of the trees in a stand are removed in one cutting.

**Coarse woody debris** - a tree or a portion of a tree that has fallen or been cut and left in the stand.

**Coefficient of variation** - a statistical method of measuring the amount of variation in a group, calculated as the standard deviation/mean average.

**Cohort** - a group of trees of the same age within a stand.

**Commercial thinning** - the harvest of generally merchantable trees from a stand, usually to encourage growth of the remaining trees.

**Conformance** - means that a proposed action shall be specifically provided for in the land use plan or, if not specifically mentioned, shall be clearly consistent with the goals, objectives, or standards of the approved land use plan.

**Cooperating agency** - assists the lead federal agency in developing an EA or EIS. The Council on Environmental Quality regulations implementing NEPA define a cooperating agency as any agency that has jurisdiction by law or special expertise for proposals covered by NEPA (40 CFR 1501.6). Any tribe or Federal, State, or local government jurisdiction with such qualifications can become a cooperating agency by agreement with the lead agency.

**Council on Environmental Quality (CEQ)** - an advisory council to the President established by the National Environmental Policy Act of 1969. CEQ reviews federal programs for their effects on the environment, conducts environmental studies, and advises the President on environmental matters.

**Critical habitat** - (1) Specific areas within the habitat occupied by a species at the time it is listed under the Endangered Species Act where there are physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection, and (2) specific areas outside the habitat occupied by the species at the time it is listed upon the determination by the Secretary of the Interior that such areas are essential for the conservation of the species.

**Crown** - the upper part of a tree that carries the main system of branches and the foliage.

**Cumulative effects** - impacts on the environment resulting from the incremental effect of the action when added to effects of past, present, and reasonably foreseeable future actions regardless of the agency (federal or nonfederal) or person undertaking such other actions. Cumulative effects can result from individually minor, but collectively similar, actions occurring over a period of time.

**Decision Record** - a document separate from, but associated with, an environmental assessment, that states the management decision on a proposed action resulting in a Finding of No Significant Impact.

**Density-dependent mortality** - a source of tree death that increases as the number of trees in a given area increases, which typically kills the smaller trees in a stand, e.g., suppression by competition for light.

**Density-independent mortality** - a source of tree death that does not increase as the number of trees in a given area increases, e.g., lightning strikes.

**Diameter at breast height (dbh)** - the diameter of a tree 4.5 feet above the ground on the uphill side of the tree.

**Differentiation** - the process by which individual trees in a cohort develop different growth rates and canopy positions.

**Draft Environmental Impact Statement (DEIS)** - the draft statement of environmental effects, which is required for major federal actions under Section 102 of the National Environmental Policy Act, and released to the public and other agencies for comment and review.

**Effects** - effects, impacts, and consequences, as used in this environmental impact statement, are synonymous. Effects may be direct, indirect, or cumulative and may fall in one of these categories: aesthetic, historic, cultural, economic, social, health, or ecological (such as effects on natural resources and on the components, structures, and functioning of affected ecosystems).

**Endangered species** - a species defined in accordance with the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range.

**Endangered Species Act (ESA)** - a federal law passed in 1973 to conserve species of wildlife and plants determined by the Director of the U.S. Fish and Wildlife Service or the National Marine Fisheries Service to be endangered or threatened with extinction in all or a significant portion of its range. Among other measures, ESA requires all federal agencies to conserve these species and consult with the U.S. Fish and Wildlife Service or National Marine Fisheries Service on federal actions that may affect these species or their designated critical habitat.

**Environmental Assessment (EA)** - a systematic analysis of site specific activities used to determine whether such activities would have a significant effect on the quality of the human environment, whether a formal environmental impact statement is required, and also to aid agency compliance with the National Environmental Policy Act when no environmental impact statement is necessary.

**Environmental Impact Statement (EIS)** - a statement of the environmental effects of a proposed action and alternatives to it. It is required for major federal actions under Section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review. It is a formal document that must follow the requirements of NEPA, the CEQ guidelines, and directives of the agency responsible for the project proposal.

**Fire management plan** - a strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans.

**Forest Ecosystem Management Assessment Team (FEMAT)** - an interagency, interdisciplinary team of scientists, economists, and sociologists led by Dr. Jack Ward Thomas and chartered in 1993 to review proposals for management of federal forests within the range of the northern spotted owl. The team produced a report in July 1993 assessing ten options in detail, which were used as a basis for developing the Northwest Forest Plan.

**Fragmentation** - a process of reducing size and connectivity of stands that compose a forest.

**Habitat** - a place or environment where a plant or animal naturally or normally lives and grows.

**Height**: diameter ratio - the ratio of tree height to tree diameter (dbh), which indicates the mechanical stability of the tree.

**Interdisciplinary team (ID team)** - a group of individuals with varying areas of specialty assembled to solve a problem or perform a task.

**Intermittent stream** - a non-permanent, flowing drainage feature having a definable channel and evidence of annual scour or deposition.

**Irretrievable** - applies to losses of production, harvest, or commitment of renewable natural resources. For example, some or all of the timber production from an area is irretrievably lost during the time an area is used as a winter sports site. If the use is changed, timber production can be resumed. The production lost is irretrievable, but the action is not irreversible.

**Irreversible** - a term that describes the loss of future options. Applies primarily to the effects, or use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time.

**Issue** - a point, matter, or question of public discussion or interest to be addressed or decided through the planning process.

**Landing** - a place on or adjacent to the logging site where logs are assembled for further transport.

**Known site** - historic and current location of a species reported by a credible source, available to field offices, and that does not require additional species verification or survey to locate the species.

**Land use allocation** - commitment of a given area of land or a resource to one or more specific uses (such as campgrounds or Wilderness). In the Northwest Forest Plan, one of the seven allocations of Congressionally Withdrawn Areas, Late-Successional Reserves, Adaptive Management Areas, Managed Late-Successional Areas, Administratively Withdrawn Areas, Riparian Reserves, or Matrix.

**Landscape** - a heterogeneous land area with interacting ecosystems repeated in similar form throughout .

**Late-successional forests** - forest stands consisting of trees, structural attributes, supporting biological communities, and processes associated with old-growth and/or mature forests. Forest seral stages that include mature and old-growth age classes. Age is not necessarily a defining characteristic but has been used as a proxy or indicator in some usages. Minimum ages are typically 80 to 130 years, more or less, depending on the site quality, species, rate of stand development, and other factors.

**Late-Successional Reserves (LSR)** - a land use allocation under the Northwest Forest Plan with the objective to protect and enhance conditions of late-successional and old-growth forest ecosystems that serve as habitat for late-successional and old-growth forest related species, including the northern spotted owl.

**Late-Successional Reserve Assessment** - a systematic management assessment that characterizes the conditions within an LSR (or group of LSRs) and establishes criteria for treatments.

**Management Recommendation** - an interagency document that addresses how to manage known sites and that provide guidance to agency efforts in conserving Survey and Manage species.

**Matrix** - a land use allocation under the Northwest Forest Plan of the federal lands outside of reserves, withdrawn areas, Managed Late-Successional Areas, and Adaptive Management Areas.

**Mature forest** - a subset of late-successional forests. Mature forests are characterized by the onset of slowed height growth, crown expansion, heavier limbs, gaps, some mortality in larger trees, and appearance of more shade-tolerant species or additional crown layers. In Douglas-fir forests west of the Cascade Mountains, this stage typically begins between 80 and 130 years, depending on site conditions and stand history.

**Mid-seral stands** - forest stands that are not yet late-successional, defined here as stands 51-80 years old.

**Mitigation measures** - modifications of actions taken to: (1) avoid impacts by not taking a certain action or parts of an action; (2) minimize impacts by limiting the degree or magnitude of the action and its implementation; (3) rectify impacts by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or, (5) compensate for impacts by replacing or providing substitute resources or environments.

**Monitoring** - a process of collecting information to evaluate if objectives and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned.

**National Environmental Policy Act (NEPA)** - a federal law passed in 1969 to declare a National policy that encourages productive and enjoyable harmony between humankind and the environment, promotes efforts that prevent or eliminate damage to the environment and biosphere, stimulates the health and welfare of humanity, enriches the understanding of the ecological systems and natural resources important to the nation, and established a Council on Environmental Quality.

**Non-shared road** - a cooperating party (landowner) to a reciprocal right-of-way agreement has an implied permitted right to use the road, but has not exercised this right, nor shared in the value of the road.

**Northwest Forest Plan** - coordinated ecosystem management direction incorporated into land management plans for lands administered by the Bureau of Land Management and the Forest Service within the range of the northern spotted owl. A Record of Decision was signed on April 13, 1994, by the Secretaries of the Department of Agriculture and the Department of Interior to adopt Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (USDA, USDI 1994b). The Record of Decision, including the Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl is referred to as the Northwest Forest Plan. The Northwest Forest Plan is not a "plan " in the agency planning regulations sense; the term instead refers collectively to the 1994 amendment to existing agency unit plans or to the specific standards and guidelines for late- successional species incorporated into subsequent administrative unit plans.

**Noxious weed** - a plant specified by law as being especially undesirable, troublesome, and difficult to control.

**Old-growth associated species** - plant and animal species that exhibit a strong association with old-growth forests.

**Old-growth forest** - an ecosystem distinguished by old trees and related structural attributes. Old growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include tree size, accumulations of large dead woody material, number of canopy layers, species, composition, and ecosystem function. The Northwest Forest Plan SEIS and FEMAT describe old-growth forest as a forest stand usually at least 180 to 220 years old with moderate-to-high canopy closure; a multi-layered, multi-species canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood (decadence); numerous large snags; and heavy accumulations of wood, including large logs on the ground.

**Overstory** - trees that provide the uppermost layer of foliage in a forest with more than one roughly horizontal layer of foliage.

**Peak flow** - the highest amount of stream or river flow occurring in a year or from a single storm event.

**Perennial stream** - a stream that typically has running water on a year-round basis.

**Plantation** - a managed forest stand; defined in this EIS as a forest stand that has been established by planting or artificial seeding and has been pre-commercially thinned (or is too young to be pre-commercially thinned).

**Pre-commercial thinning (PCT)** - the silvicultural practice of cutting some of the trees less than merchantable size in a stand so that the remaining trees will grow faster, with the expectation of future commercial timber harvest. PCT is usually done in stands 10 - 20 years old.

**Prescribed fire** - a fire ignited by management actions to meet specific objectives.

**Quadratic mean diameter** - the average tree diameter of a stand, calculated as the square root of the sum of the squares of the tree diameters divided by the number of trees.

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**Record of Decision** - a document separate from, but associated with, an environmental impact statement that: states the management decision, states the reason for that decision, identifies all alternatives including the environmentally preferable and selected alternatives, and also states whether all practicable measures to avoid environmental harm from the selected alternative have been adopted, and if not, why not.

**Relative Density** - a measure of the growing space available to the average tree in a stand; calculated as the basal area divided by the square root of the quadratic mean tree diameter (Curtis 1982).

**Resource Management Plan (RMP)** - a set of decisions that establish management direction for land within an administrative area, as prescribed under the planning provisions of the Federal Land Policy and Management Act. The effects of a proposed Resource Management Plan and alternatives are analyzed in an environmental impact statement (RMP EIS).

**Riparian Reserves** - a land use allocation under the Northwest Forest Plan of areas along streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis.

**Scoping** - a process defined, according to the provisions of the National Environmental Policy Act, as an early and open process for determining the scope of the issues to be addressed and for identifying the significant issues related to a proposed action.

**Sediment yield** - the quantity of soil, rock particles, organic matter or other debris transported through a cross section of stream in a given period of time.

**Seed tree system** - an even-aged silvicultural system in which all trees are cut except for selected trees left standing to provide a seed source for natural regeneration.

**Seral stages** - the series of relatively transitory plant communities that develop during ecological succession from bare ground to the climax stage.

**Shade-tolerant conifers** - conifer tree species capable of growing well in shade, e.g., western hemlock and western red-cedar.

**Shared Roads** - a cooperating party (landowner) to a reciprocal right-of-way agreement has a shared investment in the value of the road and a permitted right to use the road. Site class - a measure of an area's relative capacity for producing timber or other vegetation.

**Site Index** - a measure of forest productivity expressed as the height of the tallest trees in a stand at an index age.

**Slash** - the branches, bark, tops, cull logs, and broken or uprooted trees left on the ground after logging.

**Snag** - a standing dead, partially dead, or defective (cull) tree.

**Special Forest Products** - firewood, shake bolts, mushrooms, ferns, floral greens, berries, mosses, bark, grasses, etc. that could be harvested in accordance with the objectives and guidelines in the RMP.

**Spur road** - a branch of a main or secondary road; limited in this EIS to a short (<200') segment of road, usually to facilitate yarding or to provide access to a landing.

**Stagnation** - cessation or severe decline of tree growth and development in a forest stand because of excessive tree density and/or poor growing conditions.

**Stand (tree stand)** - an aggregation of trees occupying a specific area and sufficiently uniform in composition, age, arrangement, and condition to be distinguishable from the forest in adjoining areas.

**Stand density** - a measurement of the number and size of trees on a forest site, which may be expressed in terms of numbers of trees per acre, basal area, stand density index, or relative density.

**Stream order** - a hydrologic system of stream classification based on stream branching. Each small unbranched tributary is a 1$^{st}$-order stream. Two 1$^{st}$-order streams join to make a 2$^{nd}$-order stream. Two 2$^{nd}$-order streams join to form a 3$^{rd}$-order stream, and so forth.

**Stream reach** - an individual 1$^{st}$-order stream or a segment of another stream that has beginning and ending points at a stream confluence. Reach end points are normally designated where a tributary confluence changes the channel character or order. In this planning area, stream reaches are generally ½ to 1½ miles in length, except where channel character, confluence distribution, or management considerations require variance.

**Succession** - a series of dynamic changes by which one group of organisms succeeds another through stages leading to a potential natural community or climax. An example is development of a series of plant communities (called seral stages) following a major disturbance.

**Suppression** - the reduction in growth and development of trees as a result of competition with larger trees.

**Survey and Manage** - a mitigation measure adopted as a standard and guideline within the Northwest Forest Plan Record of Decision that is intended to mitigate impacts of land management efforts on those species that are closely associated with late-successional or old-growth forests and whose long-term persistence is a concern.

**Threatened species** - a species defined in accordance with the Endangered Species Act as being likely to become endangered throughout all or a significant portion of its range within the foreseeable future.

**Underplanting** - planting tree seedlings under an existing forest overstory.

**Understory** - the trees and other woody species growing under the canopies of larger adjacent trees.

**Watershed analysis** - a systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Watershed analysis provides a basis for ecosystem management planning that is applied to watersheds of approximately 20 to 200 square miles.

**Wildfire** - an unwanted wildland fire.

**Windthrow** - a tree or trees uprooted or felled by the wind.

**Yarding** - the act or process of moving logs to a landing.

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# Acronyms

## List of Acronyms and Abbreviations Used Within this Document

ACS - Aquatic Conservation Strategy
BOD - biological oxygen demand
BLM - Bureau of Land Management
BMP - Best Management Practice
CEQ - Council on Environmental Quality
CHU - Critical Habitat Unit
CFR - Code of Federal Regulations
CV - coefficient of variation
DEQ - Department of Environmental Quality
dbh - diameter breast height
DMA - Designated Management Agency
DNA - Documentation of Land Use Plan Conformance and NEPA Adequacy
DO - dissolved oxygen
EA - Environmental Assessment
EIS - Environmental Impact Statement
EPA - Environmental Protection Agency
ESA - Endangered Species Act
FEMAT - Forest Ecosystem Management Assessment Team
FOI - Forest Operations Inventory
FSEIS - Final Supplemental Environmental Impact Statement
FVS - Forest Vegetation Simulator
FWS - U.S. Fish and Wildlife Service
GIS - Geographic Information System
H:D - height:diameter ratio
LMS - Landscape Management System
LSR - Late-Successional Reserve
MBF - thousand board feet
NEPA - National Environmental Policy Act
NMFS - National Marine Fisheries Service (NOAA Fisheries)
NOAA - National Oceanic and Atmospheric Adiministration
ODEQ - Oregon Department of Environmental Quality
ODFW - Oregon Department of Fish and Wildlife
PCT - pre-commercial thinning
RD - relative density
ROD - Record of Decision
RMP - Resource Management Plan
RMP EIS - Resource Management Plan Environmental Impact Statement
SEIS - Supplemental Environmental Impact Statement
SVS - Stand Visualization System
T&E - threatened and endangered
TMDL - Total Maximum Daily Limit
TPA - trees per acre
USDA - United States Department of Agriculture
USDI - United States Department of the Interior

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# References

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All of the following publications and documents are available for review at the Eugene District Office, in addition to the other sources listed.

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# APPENDIX A
# Detailed Description of the Action Alternatives

This appendix describes the action alternatives in detail. Each alternative is described in terms of the goals, objectives, actions, guidelines, and mitigation measures. The terms, "goals", "objectives", and "guidelines" have the specific meanings, as defined in the BLM Planning Handbook:

> goal: a broad statement of a desired outcome. Goals are usually not quantifiable and may not have established time frames for achievement.
>
> objective: a description of a desired condition for a resource. Objectives can be quantified and measured and, where possible, have established time frames for achievement.
>
> guidelines: actions or management practices that may be used to achieve desired outcomes, sometimes expressed as best management practices.

(BLM Handbook H-1601-1, Appendix A; available online: http://www.blm.gov/nhp/efoia/wo/handbook/h1601-1.pdf ).

The goals are the same for each alternative: they are the three purposes of the action defined in Chapter 1 of this EIS. The objectives are the heart of the alternatives and vary considerably among the alternatives. Each alternative's set of objectives represents a different way of achieving the same set of goals. The "actions" are the specific management actions that would be taken to achieve a specific objectives. The guidelines are intended to be advisory rather than absolute in nature. For some actions, specific "mitigations measures" are presented to make the effect of the action less harsh or severe.

# ALTERNATIVE B

## Plantation and Road Management with No Timber Harvest

Restore plantations and roads and let nature do the rest

### GOAL 1: Prctect and enhance late-successional and old-growth forest ecosystems.

**OBJECTIVE:** **On decommissioned and BLM-controlled roads, control noxious weeds within 10 years sufficient to ensure they do not penetrate into late-successional stands.**

**ACTION:** Inventory roads within or adjacent to late-successional stands for the presence of noxious weeds.

**ACTION:** Remove noxious weeds from BLM-controlled roads, including roads to be decommissioned.

**ACTION:** Plant trees or other native species in the decommissioned roads to prevent noxious weeds from becoming established in areas where weed seed is likely to spread into the decommissioned roads.

**GUIDELINE:**

- Use methods to remove weeds such as mowing, pulling, cutting and grubbing depending on the weed species.

**OBJECTIVE:** **Decommission all roads where legally possible within 10 years. (See Goal #3).**

**ACTION:** Decommission the roads shown in Appendix E.

**GUIDELINE**

- In determining the timing for decommissioning, consider the road's risk ratings in the TMP, and the need for the road to complete other management actions beyond the late-successional stand.

**ACTION:** Decommission unnumbered roads and non-designated trails as needed to protect and enhance late-successional forests.

**ACTION:** On roads to be decommissioned, break up areas of soil compaction of the road surface (by subsoiling or other such methods) as needed to allow tree establishment and growth.

**GUIDELINES:**

- Where subsoiling or other such methods will not be sufficient to allow tree establishment and growth, recontour the road area to create better tree growing conditions.

- Coordinate thinning and coarse woody debris creation in adjacent stands to fall some trees across decommissioned roads to cover soil and block access.

**ACTION:** Plant trees or other native species on the decommissioned road surface when needed to ensure tree establishment.

**ACTION:** Block decommissioned roads as needed to restrict vehicular traffic.

## GOAL 2: Foster the development of late-successional forest structure and composition in plantations and young forests within LSR 267.

**OBJECTIVE: Reduce tree density and increase variability of tree spacing in 90% (100% of stands; 90% of acres) of the 1-20 year age class, so that tree densities range from 40-110 TPA by age 21.**

**ACTION:** Thin approximately 1/3 of stands aged 11 to 20 years to a stand average of 40-60 Douglas-fir trees per acre, with variable spacing.

**ACTION:** Thin approximately 1/3 of stands aged 11 to 20 years to a stand average of 60-80 Douglas-fir trees per acre, with variable spacing.

**ACTION:** Thin approximately 1/3 of stands aged 11 to 20 years to a stand average of 80-110 Douglas-fir trees per acre, with variable spacing.

**GUIDELINES:**
- Select only Douglas-fir for cutting.
- Select trees for retention based on random or highly variable spacing.
- Leave all cut trees in the stand.

**MITIGATION MEASURES:**
- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, minimize thinning along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**OBJECTIVE: Reduce tree density and increase variability of tree spacing in 75% (80% of stands; 95% of acres) of the 21-40 year age classes, so that tree densities range from 50-150 TPA of Douglas-fir by age 41.**

**ACTION:** Thin plantations aged 21 to 30 years to a treated stand average of 50-100 Douglas-fir trees per acre.

**ACTION:** Thin plantations aged 31 to 40 years to a treated stand average of 100-150 Douglas-fir trees per acre.

**GUIDELINES:**
- Select only Douglas-fir for cutting.
- Thin from below: select the largest, most vigorous trees for retention without regard for tree spacing. Diameter limit prescriptions ranging from 10" dbh to 12" dbh might be typical.
- Leave all cut trees in the stand.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**
- Limit the cutting of trees >12" dbh to lessen the risk of Douglas-fir bark beetle infestation. (Some trees >12" dbh will be specifically selected for snag and/or coarse woody debris creation).

- Lessen fire risk from thinning by not creating high fuel loads near roads. Appropriate mitigations include measures such as pulling-back cut trees from road edge; hand-piling and burning cut trees; or leaving part of the stand unthinned.
- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds.
- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile.
- Avoid creating large concentrations of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.

**OBJECTIVE:** **Reduce tree density and increase variability of tree spacing in 75% (80% of stands; 95% of acres) of the 41-50 year age classes, so that tree densities range from 100-200 TPA of Douglas-fir by age 51.**

**ACTION:** Thin plantations aged 41 to 50 years to a treated stand average of 100-200 Douglas-fir trees per acre.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Thin from below: select the largest, most vigorous trees for retention without regard for tree spacing. A diameter limit prescription of 12" dbh might be typical.
- Leave all cut trees in the stand.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**

- Limit the cutting of trees >12" dbh to lessen the risk of Douglas-fir bark beetle infestation. (Some trees >12" dbh will be specifically selected for snag and/or coarse woody debris creation).
- Lessen fire risk from thinning by not creating high fuel loads near roads. Appropriate mitigations include measures such as pulling-back cut trees from road edge; hand-piling and burning cut trees; or leaving part of the stand unthinned.
- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds.
- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile.
- Avoid creating large concentration of fallen trees with intact needles or leaves in areas with poor oxygen reaeration (e.g., stream reaches with high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (i.e., summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.

**OBJECTIVE:** **In stands treated under the above objectives, develop densities of shade-tolerant conifers to ensure that by age 81, they contain densities similar to those found in mature natural stands (26-90 TPA >2" dbh).**

**ACTION:** In stands thinned at ages 31-50, plant seedlings of shade-tolerant conifers at densities of 26-200 trees per acre.

**GUIDELINES:**
- Planting may be concentrated in distribution in response to site-specific conditions, such as overstory density, shrub competition, and ground disturbance, and need not be evenly distributed across the stand. Planting densities should generally be met at the scale of 10 acres (e.g., 260-2000 trees/10 acres).

**OBJECTIVE:** **In stands treated under the above objectives, develop quantities of snags and coarse woody debris to ensure that by age 81, they contain amounts consistent with Alternative #2 in the LSR Assessment (1102-3794 cu. ft./acre).**

**ACTION:** In stands thinned at ages 21-50, thinning prescriptions described above would include cutting 5-10 Douglas-fir trees/acre >12" dbh (>150 cu.ft./acre) for coarse woody debris at the time of thinning operations. Total coarse woody debris minimum targets of 551 cu.ft./acre would typically be exceeded by the trees<12" dbh cut as part of thinning operations (which would typically create >1000 cu.ft./acre of coarse woody debris).

**GUIDELINES:**
- Coarse woody debris should mostly be concentrated in distribution to provide planting sites for shade-tolerant conifers. Coarse woody debris levels should generally be met at the scale of 10 acres (e.g., 5510 cu.ft./10 acres).

**ACTION:** In stands thinned at ages 21-50, create sufficient snags to meet stand average snag levels of at least 551 cu.ft./acre. Snags may be created by a variety of methods, including girdling, topping, blasting, and/or fungal inoculation.

**GUIDELINES:**
- Snag creation may be done at the time of thinning or delayed to allow time to assess natural tree mortality levels following thinning. Regardless, snag levels should be met within 5 years of the thinning operations.
- Snags should mostly be concentrated in distribution to provide planting sites for shade-tolerant conifers. Snag levels should generally be met at the scale of 10 acres (e.g., 5510 cu.ft./10 acres). Individual snag patches (i.e., areas in which all Douglas-fir trees are killed) should generally be limited to less than 1/4 acre in size.
- At least half of the trees left for snags should have diameters greater than the pre-treatment stand average diameter.

## GOAL 3: Reconnect streams and reconnect stream channels to their riparian zones and upslope areas within LSR 267.

**OBJECTIVE:** **Decommission all roads where legally possible within 10 years.**

**ACTION:** Decommission the roads shown in Appendix E.

**GUIDELINES:**
- Decommissioning may include any of the following measures:
  - discontinuing road maintenance;
  - tilling the road surface with dozer and subsoiler implement or a track mounted excavator;
  - removing gravel or pulling of gravel into the ditch line;
  - scarifying roads for creation of planting areas;

  - removing side cast soils from fill slopes with a high potential for triggering landslides;
  - filling and contouring of cut slope ditch lines to the adjacent hill slope;
  - removing culverts;
  - stabilizing stream crossings (e.g., recountering stream channels, placement of mulch or mats and seeding for erosion control, placement of rock and logs);
  - installing water bars, cross sloping or drainage dips to ensure adequate drainage into vegetated areas and away from streams or unstable road fills;
  - blocking the road using barricades, gating, or earth berm barriers;
  - placing slash, boulders, and/or woody debris on the road surface to deflect runoff, discourage OHV use, and promote vegetative growth;
  - seeding or planting for erosion control.
- Along roads being decommissioned, generally remove culverts and recontour stream channels to achieve streambank stability.

**ACTION:** On roads to be decommissioned, subsoil (i.e., break up areas of soil compaction) the road surface sufficient to allow tree establishment and growth.

**GUIDELINES:**

- Where subsoiling will not be sufficient to allow tree establishment and growth, recontour the road area to create better tree growing conditions.
- Coordinate thinning and coarse woody debris creation in adjacent stands to fall some trees across decommissioned roads to cover soil and block access.

**ACTION:** Plant trees or other native species on decommissioned road surface when needed to ensure tree establishment.

**ACTION:** Block decommissioned road as needed to restrict vehicular traffic.

**OBJECTIVE: On roads that will not be decommissioned, reduce the risk to the aquatic ecosystem attributable to the road network within 10 years.**

**ACTION:** Eliminate all barriers to movements of anadromous fish and other aquatic organisms attributable to BLM-controlled roads.

**GUIDELINES:**

- Barriers may be eliminated by removal, replacement, or modification of culverts, and/or installation of downstream structures to raise upstream water levels within culverts or upstream structure to stabilize accumulated deposition.

**ACTION:** Develop and implement Memoranda of Understanding with adjacent road- and land-owners to eliminate barriers to movements of anadromous fish and other aquatic organisms attributable to non-BLM roads or lands.

**ACTION:** Remove or replace culverts that have a high risk of failure.

**GUIDELINES:**

- Along roads that will not be decommissioned, replace existing culverts that are failed, undersized, or constitute passage barriers. An existing culvert may be replaced with another culvert, a half-arch or a bridge.
- For culverts creating a passage barrier, where removal or replacement are not feasible, access to the culvert may be created or improved by downstream log or boulder structure designed to elevate the stream channel and create pools to facilitate movement into the culvert. Downstream structures may also be used in conjunction with culvert replacement to improve passage.

# ALTERNATIVE C

## Continue Current Management Approach

Manage young stands using current silvicultural techniques and continue riparian restoration at the current pace

### GOAL 1: Protect and enhance late-successional and old-growth forest ecosystems.

**OBJECTIVE:** **On decommissioned and BLM-controlled roads, control noxious weeds within 10 years sufficient to ensure they do not penetrate into late-successional stands.**

**ACTION:** Inventory roads within or adjacent to late-successional stands for the presence of noxious weeds.

**ACTION:** Remove noxious weeds from BLM-controlled roads, including roads to be decommissioned.

**ACTION:** Plant trees or other native species in the decommissioned roads to prevent noxious weeds from becoming established in areas where weed seed is likely to spread into the decommissioned roads.

**GUIDELINE:**

- Use methods to remove weeds such as mowing, pulling, cutting and grubbing depending on the weed species.

**OBJECTIVE:** **Decommission or close and stabilize non-shared, BLM-controlled roads that (1) are capable of delivering sediment to streams, (2) are damaged and not needed for future access, or (3) dead-end in late-successional stands.**

**ACTION:** Decommission the roads shown in Appendix E.

**GUIDELINE:**

- In determining the timing for decommissioning, consider the need for the road to complete other management actions beyond the late-successional stand.

**ACTION:** On roads to be decommissioned, break up areas of soil compaction of the road surface (by subsoiling or other such methods) as needed to allow tree establishment and growth.

**GUIDELINES:**

- Where subsoiling or other such methods will not be sufficient to allow tree establishment and growth, recontour the road area to create better tree growing conditions.
- Coordinate thinning and coarse woody debris creation in adjacent stands to fall some trees across decommissioned roads to cover soil and block access.

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**ACTION:** Plant trees or other native species on the decommissioned road surface when needed to ensure tree establishment.

**ACTION:** Block decommissioned roads as needed to restrict vehicular traffic.

## GOAL 2: Foster the development of late-successional forest structure and composition in plantations and young forests within LSR 267.

**OBJECTIVE: Reduce tree density while maintaining even spacing in 100% of the 1-20 year age class that has not been pre-commercially thinned, so that tree densities range from 100-220 TPA by age 21.**

**ACTION:** Thin 90% of stands aged 11 to 20 years at 14' x 14' to 17' x 17' conifer spacing, with even spacing and consistent tree density within stands ("pre-commercial thinning").

**ACTION:** Thin 10% of stands aged 11 to 20 years at 20' x 20' conifer spacing, with even spacing and consistent tree density within stands ("pre-commercial thinning").

**GUIDELINES:**
- Select the largest, most vigorous trees for retention within overall even spacing.
- Leave most or all cut trees in the stand.
- Retain most minor conifers (i.e., western hemlock, western red-cedar, grand fir, and incense-cedar) as part of the overall conifer spacing, giving greater preference to minor conifers when they are more scarce.
- Retain most larger hardwoods (typically retain hardwoods >12" dbh).
- Generally avoid thinning within 10' of perennial streams.

**OBJECTIVE: Reduce tree density in 900 acres (40% of stands; 50% of acres) of the 41-80 year age classes, so that tree densities range from 40-110 TPA by age 80.**

**ACTION:** Thin 20% (40% of stands; 50% of acres) of stands aged 41 to 50 years by commercial timber sale. Retain between 60-110 trees per acre.

**ACTION:** Thin 20% (40% of stands; 50% of acres) of stands aged 51 to 80 years by commercial timber sale. Retain between 50-110 trees per acre.

**GUIDELINES:**
- Thin from below: select the largest, most vigorous trees for retention.
- Retain lower tree densities in stands that were previously commercially thinned.
- Retain minor conifers (e.g., western hemlock, western red-cedar, grand fir, and incense-cedar) and hardwoods, except for safety or operational reasons.
- Retain existing snags and coarse woody debris of decay classes 3, 4, and 5, except for safety or operational reasons.
- Retain in the stand any snags felled for safety or operational reasons.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.
- Avoid thinning within 50' of streams (or the topographic break, whichever is greater).
- Give preference to stands with existing road systems that allow thinning with the least new road construction.

**MITIGATION MEASURES**

- Do not reduce stand average canopy closure below 40% to maintain spotted owl dispersal habitat.
- Evaluate stands ≥51 years old with older remnant trees for potential marbled murrelet habitat. Survey potential habitat or leave untreated.

**ACTION:** Construct new roads and renovate existing roads as needed to access areas selected for thinning.

**GUIDELINES:**

- Generally avoid constructing new stream crossings.
- Where new stream crossings are required, use temporary roads that are decommissioned after a single logging season.

**MITIGATION MEASURES:**

- Do not build new roads in stands >80 years old.
- Waterbar temporary roads between logging seasons.
- Subsoil temporary roads upon completion of project as needed to reduce soil compaction.
- Block decommissioned roads to restrict vehicular access.

**OBJECTIVE: In stands treated under the above objectives, develop densities of shade-tolerant conifers to ensure that by age 81, they contain densities similar to those found in mature natural stands (26-90 TPA >2" dbh).**

**ACTION:** Within stands that are thinned to below 80 TPA and lack sufficient shade-tolerant conifer trees or seedlings to meet the objective, plant seedlings of shade-tolerant conifers (western hemlock, western red-cedar, grand fir, incense-cedar and/or Pacific yew) at densities of 100-200 trees per acre.

**GUIDELINES:**

- Give preference in planting to areas with the greatest likelihood of seedling establishment and growth, considering factors such as post-thinning overstory density and shrub competition.
- Within areas selected for planting, plant seedlings with even spacing.

**OBJECTIVE: In stands treated under the above objectives, develop quantities of snags and coarse woody debris to ensure that by age 81, they contain amounts consistent with Alternative #3 in the LSR Assessment (525-2844 cu. ft./acre).**

**ACTION:** Cut and leave 3-15 Douglas-fir trees per acre as coarse woody debris (approximately 100-500 cu.ft./acre) in stands thinned at ages 41-80 in which coarse woody debris needs are not being met.

**ACTION:** Create snags by killing 1-3 Douglas-fir trees per acre (approximately 30-100 cu.ft./acre) in stands thinned at ages 41-80 in which snag needs are not being met. Snags may be created by a variety of methods, including girdling, topping, blasting, and/or fungal inoculation.

**GUIDELINES:**

- Snag and coarse woody debris creation may be done at the time of thinning or delayed to allow time to assess natural tree mortality levels following thinning. Regardless, snag and coarse woody debris levels should be met within 10 years of the thinning operations.

- Coarse woody debris and snags may be concentrated in distribution and need not be evenly distributed across the stand. Coarse woody debris and snag levels should generally be met at the scale of 10 acres. Individual coarse woody debris and snag patches (i.e., areas in which all Douglas-fir trees are cut or killed) should generally be limited to less than 1/4 acre in size.

## GOAL 3: Reconnect streams and reconnect stream channels to their riparian zones and upslope areas within LSR 267.

**OBJECTIVE: Decommission or improve all roads capable of delivering sediment to streams, as identified in watershed analysis within 10 years.**

**ACTION:** Decommission the roads shown in Appendix E.

**GUIDELINES:**

- Decommissioning may include any of the following measures:
  - discontinuing road maintenance;
  - tilling the road surface with dozer and subsoiler implement or a track mounted excavator;
  - removing gravel or pulling of gravel into the ditch line;
  - scarifying roads for creation of planting areas;
  - removing side cast soils from fill slopes with a high potential for triggering landslides;
  - filling and contouring of cut slope ditch lines to the adjacent hill slope;
  - removing culverts;
  - stabilizing stream crossings (e.g., recountering stream channels, placement of mulch or mats and seeding for erosion control, placement of rock and logs);
  - installing water bars, cross sloping or drainage dips to ensure adequate drainage into vegetated areas and away from streams or unstable road fills;
  - blocking the road using barricades, gating, or earth berm barriers;
  - placing slash, boulders, and/or woody debris on the road surface to deflect runoff, discourage OHV use, and promote vegetative growth;
  - seeding or planting for erosion control.
- Along roads being decommissioned, generally remove culverts and recontour stream channel to achieve streambank stability.

**ACTION:** On roads to be decommissioned, break up areas of soil compaction of the road surface (by subsoiling or other such methods) as needed to allow tree establishment and growth.

**GUIDELINES:**

- Where subsoiling or other such methods will not be sufficient to allow tree establishment and growth, recontour the road area to create better tree growing conditions.
- Coordinate thinning and coarse woody debris creation in adjacent stands to fall some trees across decommissioned roads to cover soil and block access.

**ACTION:** Plant trees or other native species on decommissioned road surface when needed to ensure tree establishment.

**ACTION:** Block decommissioned road as needed to restrict vehicular traffic.

**OBJECTIVE: On roads that will not be decommissioned, reduce the risk to the aquatic ecosystem attributable to the road network within 10 years.**

**ACTION:** Eliminate all barriers to movements of anadromous fish attributable to BLM-controlled roads.

**GUIDELINES:**
- Barriers may be eliminated by removal, replacement, or modification of culverts, and/or installation of downstream structures to raise upstream water levels within culverts or upstream structure to stabilize accumulated deposition.

**ACTION:** Develop and implement Memoranda of Understanding with adjacent road- and land-owners to eliminate barriers to movements of anadromous fish attributable to non-BLM roads or lands.

**ACTION:** Remove or replace culverts that have a high risk of failure.

**GUIDELINES:**
- Along roads that will not be decommissioned, replace existing culverts that are failed, undersized, or constitute passage barriers. An existing culvert may be replaced with another culvert, a half-arch or a bridge.
- For culverts creating a passage barrier, where removal or replacement are not feasible, access to the culvert may be created or improved by downstream log or boulder structure designed to elevate the stream channel and create pools to facilitate movement into the culvert. Downstream structures may also be used in conjunction with culvert replacement to improve passage.

**OBJECTIVE: Increase stream structure to 56 structures/stream mile along 3.8 miles of streams within 10 years.**

**ACTION:** Construct woody debris structures with at least 3 key pieces/structure in 3rd, 4th, or 5th-order streams.

**GUIDELINES:**
- Key pieces should generally be greater than 50' long and 24"dbh.
- Cable or otherwise stabilize structures as needed in streams that are devoid of existing stable structure that has the potential to accumulate future woody debris recruitment.
- Wood imported from off-site (e.g., purchased logs or any other logs not from adjacent or nearby stands) should generally be used in structures on 4th and 5th-order streams.

**ACTION:** In riparian Douglas-fir stands 80 years old and adjacent to upland thinning actions, fall or pull over trees into the stream to increase levels to 50-160 pieces/stream mile of woody debris.

**GUIDELINES:**
- Fall or pull trees from between 25' and 100' from the stream channel.
- Fall or pull trees from across the range of diameter classes in the stand.
- Generally select Douglas-fir for falling or pulling.
- The number of trees to be felled or pulled will be determined by site-specific factors such as stream size, existing stream structure, and riparian stand conditions.

**OBJECTIVE: In 5% of riparian (<100' from stream) hardwood-dominated stands, attain 75% canopy cover of conifers by age 81.**

**ACTION:** Cut hardwoods and shrubs to provide growing space for conifers in hardwood-dominated stands in riparian zone (i.e., <100' from streams).

**GUIDELINES:**

- Cut or girdle competing hardwoods and shrubs to release existing conifer saplings or to create planting sites for conifers
- Select for cutting primarily red alder and tall shrubs, such as salmonberry, that compete aggressively with conifer saplings.
- Some trees may be girdled instead of cut to create snags.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).

**ACTION:** Plant conifer seedlings and/or saplings in hardwood-dominated stands that were treated under the previous action and lack sufficient conifers to meet objective densities.

**GUIDELINES:**

- Species planted will be primarily western red-cedar and Douglas-fir, but may also include western hemlock and grand fir, depending on specific site conditions.
- Give preference in planting to areas with the greatest likelihood of conifer establishment and growth, considering factors such as soil conditions, overstory density and shrub competition.
- Planting may be concentrated in distribution in response to site-specific conditions and need not be evenly distributed across the stand.
- Tube western red-cedar seedlings to reduce browsing.
- Control competing shrub vegetation by placing mats or mulch around the trees or by cutting competing shrubs at planting and during subsequent years as needed to establish trees.

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# ALTERNATIVE D

## T&E Species Recovery

Maximize the development of habitat for spotted owls, marbled murrelets, and coho salmon where possible with minimal impacts to existing habitat

### GOAL 1: Protect and enhance late-successional and old-growth forest ecosystems.

**OBJECTIVE: On decommissioned and BLM-controlled roads, control noxious weeds within 10 years sufficient to ensure they do not penetrate into late-successional stands.**

**ACTION:** Inventory roads within or adjacent to late-successional stands for the presence of noxious weeds.

**ACTION:** Remove noxious weeds from BLM-controlled roads, including roads to be decommissioned.

**ACTION:** Plant trees or other native species in the decommissioned roads to prevent noxious weeds from becoming established in areas where weed seed is likely to spread into the decommissioned roads.

**GUIDELINES:**

- Use methods to remove weeds such as mowing, pulling, cutting and grubbing depending on the weed species.

**OBJECTIVE: Decommission all non-shared, BLM-controlled roads within or adjacent to late-successional stands within 10 years.**

**ACTION:** Decommission the roads shown in Appendix E.

**GUIDELINES:**

- In determining the timing for decommissioning, consider whether the road would provide access for other management actions.

**ACTION:** Decommission unnumbered roads and non-designated trails as needed to protect and enhance late-successional forests.

**ACTION:** On roads to be decommissioned, break up areas of soil compaction of the road surface (by subsoiling or other such methods) as needed to allow tree establishment and growth.

**GUIDELINES:**

- Where subsoiling or other such methods will not be sufficient to allow tree establishment and growth, recontour the road area to create better tree growing conditions.
- Coordinate thinning and coarse woody debris creation in adjacent stands to fall some trees across decommissioned roads to cover soil and block access.

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**ACTION:** Plant trees or other native species on the decommissioned road surface when needed to ensure tree establishment.

**ACTION:** Block decommissioned roads as needed to restrict vehicular traffic.

## GOAL 2: Foster the development of late-successional forest structure and composition in plantations and young forests within LSR 267.

**OBJECTIVE: Reduce tree density and increase variability of tree spacing in 90% (100% of stands; 90% of acres) of the 1-20 year age class that has not been pre-commercially thinned, so that tree densities range from 75-150 TPA by age 21.**

**ACTION:** Thin approximately 1/3 of stands aged 11 to 20 years to a stand average of 75-100 Douglas-fir trees per acre.

**ACTION:** Thin approximately 1/3 of stands aged 11 to 20 years to a stand average of 100-120 Douglas-fir trees per acre.

**ACTION:** Thin approximately 1/3 of stands aged 11 to 20 years to a stand average of 120-150 Douglas-fir trees per acre.

**GUIDELINES:**
- Select only Douglas-fir for cutting.
- Select the largest, healthiest trees for retention, regardless of spacing.
- Leave most or all cut trees in the stand.
- Generally apply the lower density prescriptions to the older stands within the age class.

**MITIGATION MEASURES:**
- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**OBJECTIVE: Reduce tree density and increase variability of tree spacing in 90% (100% of stands; 90% of acres) of the 1-20 year age class that has been pre-commercially thinned, so that tree densities range from 40-60 TPA (within 10 years).**

**ACTION:** Thin stands in uplands (i.e., >100' from streams) to a treated stand average of 40-60 Douglas-fir trees per acre, with variable spacing.

**GUIDELINES:**
- Select only Douglas-fir for cutting.
- Select trees for retention based on random or highly variable spacing. Select trees <20" dbh approximately in proportion to their abundance amongst diameter classes.
- Do not select trees >20" dbh for cutting. Leave in the stand any trees >20" dbh felled for safety or operational reasons.
- Leave in the stand any cut trees >16" dbh.
- Remove cut trees <16" dbh as necessary to reduce risk of fire or insect infestation. Some removal will generally be necessary in stands that have been pre-commercially thinned more than 8 years ago.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

- Generally apply thinning more than 8 years after pre-commercial thinning.

**MITIGATION MEASURES:**

- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**ACTION:** Thin stands in riparian zone (i.e., <100' from streams) to a treated stand average of 60-110 Douglas-fir trees per acre.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Thin from below: select the largest, most vigorous trees for retention within approximately even spacing to maximize individual tree growth.
- Generally leave all cut trees in the stand. Some removal may be needed to mitigate fire risk in limited locations, such as near roads.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.
- Generally apply thinning more than 8 years after pre-commercial thinning.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit the cutting of trees >12" dbh to lessen the risk of Douglas-fir bark beetle infestation. (Some trees >12" dbh will be specifically selected for snag and/or coarse woody debris creation).
- Lessen fire risk from thinning by not creating high fuel loads near roads. Appropriate mitigations include measures such as removing cut trees from the stand; pulling-back cut trees from road edge; hand-piling and burning cut trees; or leaving part of the stand unthinned.

**OBJECTIVE: Reduce tree density and increase variability of tree spacing in 75% (100% of stands; 75% of acres) of the 21-30-year age class, so that tree densities range from 40-110 TPA by age 31.**

**ACTION:** Among stands aged 21 to 30 years that were pre-commercially thinned, thin approximately 1/3 of stands in uplands (i.e., >100' from streams) to a treated stand average of 40-60 Douglas-fir trees per acre, with variable spacing.

**ACTION:** Among stands aged 21 to 30 years that were pre-commercially thinned, thin approximately 1/3 of stands in uplands (i.e., >100' from streams) to a treated stand average of 60-80 Douglas-fir trees per acre, with variable spacing.

**ACTION:** Among stands aged 21 to 30 years that were pre-commercially thinned, thin approximately 1/3 of stands in uplands (i.e., >100' from streams) to a treated stand average of 80-110 Douglas-fir trees per acre, with variable spacing.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Select trees for retention based on random or highly variable spacing. Select trees <20" dbh approximately in proportion to their abundance amongst diameter classes.
- Do not select trees >20" dbh for cutting. Leave in the stand any trees >20" dbh felled for safety or operational reasons.
- Leave in the stand any cut trees >16" dbh.
- Remove cut trees <16" dbh as necessary to reduce risk of fire or insect infestation. Some removal will generally be necessary in stands that have been pre-commercially thinned more than 8 years ago.

- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**

- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**ACTION:** Among stands aged 21 to 30 years that were not pre-commercially thinned, thin 75% of uplands (i.e., >100' from streams) to a treated stand average of 60-110 Douglas-fir trees per acre.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Thin from below: select the largest, most vigorous trees for retention without regard for tree spacing. A diameter-limit prescription of 10" dbh (i.e., all Douglas-fir <10" dbh would be cut) might be typical.
- Leave in the stand any cut trees >16" dbh, such as those felled for safety or operational reasons (trees >12" dbh will rarely be selected for cutting).
- Remove cut trees <16" dbh as necessary to reduce risk of fire or insect infestation.
- Densities may be left higher than 110 trees per acre in areas if needed to maintain stand stability.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**

- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**ACTION:** Among stands aged 21 to 30 years, thin 75% of acres of Douglas-fir stands in riparian zone (i.e., <100' from streams) to a treated stand average of 60-110 Douglas-fir trees per acre.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Thin from below: select the largest, most vigorous trees for retention within approximately even spacing to maximize individual tree growth.
- Generally leave all cut trees in the stand. Some removal may be needed to mitigate fire risk in limited locations, such as near roads.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.

- Limit the cutting of trees >12" dbh to lessen the risk of Douglas-fir bark beetle infestation. (Some trees >12" dbh will be specifically selected for snag and/or coarse woody debris creation).
- Lessen fire risk from thinning by not creating high fuel loads near roads. Appropriate mitigations include measures such as removing cut trees from the stand; pulling-back cut trees from road edge; hand-piling and burning cut trees; or leaving part of the stand unthinned.
- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**OBJECTIVE:** **Reduce tree density and increase variability of tree spacing in 50% (100% of stands; 50% of acres) of the 31-50-year age class, so that tree densities range from 40-110 TPA by age 51.**

**ACTION:** Among stands aged 31 to 50 years, thin approximately 1/4 of stands in uplands (i.e., >100' from streams) to a treated stand average of 40-60 Douglas-fir trees per acre, with variable spacing.

**ACTION:** Among stands aged 31 to 50 years, thin approximately 1/4 of stands in uplands (i.e., >100' from streams) to a treated stand average of 60-80 Douglas-fir trees per acre, with variable spacing.

**ACTION:** Among stands aged 31 to 50 years, thin approximately 1/4 of stands in uplands (i.e., >100' from streams) to a treated stand average of 80-110 Douglas-fir trees per acre, with variable spacing.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Select trees for retention based on random or highly variable spacing. Select trees <20" dbh approximately in proportion to their abundance amongst diameter classes.
- Do not select trees >20" dbh for cutting in the thinning prescription (some trees >20" dbh will be cut to meet coarse woody debris objectives). Do not harvest any trees >20" dbh felled for safety or operational reasons (though trees may be moved to provide coarse woody debris to other stands or streams).
- Remove cut trees <20" dbh as necessary to reduce risk of fire or insect infestation. Some removal will generally be necessary.
- Retain existing snags and coarse woody debris, except for safety and operational reasons.
- Retain in the stand any snags felled for safety or operational reasons.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**

- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**ACTION:** Among stands aged 31 to 50 years, thin approximately 1/4 of stands in uplands (i.e., >100' from streams) to a treated stand average of 60-110 Douglas-fir trees per acre without regard to spacing.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Thin from below: select the largest, most vigorous trees for retention without regard for tree spacing.

- Do not select trees >20" dbh for cutting in the thinning prescription (some trees >20" dbh will be cut to meet coarse woody debris objectives). Do not harvest any trees >20" dbh felled for safety or operational reasons (though trees may be moved to provide coarse woody debris to other stands or streams).
- Leave in the stand any cut trees >16" dbh (trees >12" dbh will rarely be selected for cutting).
- Remove cut trees <16" dbh as necessary to reduce risk of fire or insect infestation.
- This prescription will generally be applied to stands in which the smaller diameter trees are not expected to respond to increased growing space (e.g., high-density stands that were not pre-commercially thinned).
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**

- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**ACTION:** Among stands aged 31 to 50 years, thin 50% of acres of Douglas-fir stands in riparian zone (i.e., <100' from streams) to a treated stand average of 60-110 Douglas-fir trees per acre.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Thin from below: select the largest, most vigorous trees for retention within approximately even spacing to maximize individual tree growth.
- Generally leave all cut trees in the stand. Some removal may be needed to mitigate fire risk in limited locations, such as near roads.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Generally limit the cutting of trees >12" dbh to lessen the risk of Douglas-fir bark beetle infestation. (Some trees >12" dbh will be specifically selected for snag and/or coarse woody debris creation). Where some cutting of trees >12" dbh would be needed to achieve target stand densities, lessen the risk of Douglas-fir bark beetle infestation by falling trees in the summer, removing some cut trees, or leaving part of the stand unthinned.
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.
- Lessen fire risk from thinning by not creating high fuel loads near roads. Appropriate mitigations include measures such as removing cut trees from the stand; pulling-back cut trees from road edge; hand-piling and burning cut trees; or leaving part of the stand unthinned.
- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**OBJECTIVE:** **Reduce tree density and increase variability of tree spacing in 25% (50% of stands; 50% of acres) of the 51-60-year age class, so that tree densities range from 40-110 TPA by age 61.**

**ACTION:** Among stands aged 51 to 60 years, thin approximately ½ of stands in uplands (i.e., >100' from streams) to a treated stand average of 40-60 Douglas-fir trees per acre, with variable spacing.

**ACTION:** Among stands aged 51 to 60 years, thin approximately ½ of stands in uplands (i.e., >100' from streams) to a treated stand average of 60-80 Douglas-fir trees per acre, with variable spacing.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Select trees for retention based on a combination of thinning from below (i.e., cutting smaller diameter trees) and proportional thinning amongst the larger diameter trees (cutting trees in approximate proportion to their abundance) . This prescription will be expected to (1) cut most trees that are not expected to respond to increased growing space and (2) cut in a random or highly variable pattern some of those trees that are expected to respond to increased growing space (e.g., trees with larger diameter, lower height:diameter ratio, greater percentage of live crown, etc.).
- Do not select trees >20" dbh for cutting in the thinning prescription (some trees >20" dbh will be cut to meet coarse woody debris objectives). Do not harvest any trees >20" dbh felled for safety or operational reasons (though trees may be moved to provide coarse woody debris to other stands or streams).
- Remove cut trees <20" dbh as necessary to reduce risk of fire or insect infestation. Some removal will generally be necessary.
- Retain existing snags and coarse woody debris, except for safety or operational reasons.
- Retain in the stand any snags felled for safety or operational reasons.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.
- Generally avoid thinning within 1.5 miles of owl activity centers that currently have less than 40% suitable habitat.
- Generally avoid thinning in stands that have large residual trees, large snags, and a wide range of tree heights, because such stands may provide roosting and foraging habitat for northern spotted owls. Thinning should generally be done only in stands that exhibit a homogeneous stand structure.
- Generally avoid thinning stands with little or no late-successional forest within approximately one mile.

**MITIGATION MEASURES:**

- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.
- Evaluate stands ≥51 years old with older remnant trees for potential marbled murrelet habitat. Survey potential habitat or leave untreated.

**ACTION:** Among stands aged 51 to 60 years, thin 25% of Douglas-fir stands in riparian zone (i.e., <100' from streams) to a treated stand average of 60-110 Douglas-fir trees per acre.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Thin from below: select the largest, most vigorous trees for retention within approximately even spacing to maximize individual tree growth. (In addition to the thinning prescription, fall or pull trees if available to provide stable in-stream structure

(generally 0.6 TPA ≥24"dbh)).
- Leave all cut trees in the stand.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**
- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.
- Generally limit the cutting of trees >12" dbh to lessen the risk of Douglas-fir bark beetle infestation. (Some trees >12" dbh will be specifically selected for snag and/or coarse woody debris creation). Where some cutting of trees >12" dbh would be needed to achieve target stand densities, lessen the risk of Douglas-fir bark beetle infestation by falling trees in the summer, removing some cut trees, or leaving part of the stand unthinned.
- Lessen fire risk from thinning by not creating high fuel loads near roads. Appropriate mitigations include measures such as removing cut trees from the stand; pulling-back cut trees from road edge; hand-piling and burning cut trees; or leaving part of the stand unthinned.
- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.
- Evaluate stands ≥51 years old with older remnant trees for potential marbled murrelet habitat. Survey potential habitat or leave untreated.

**ACTION:** Renovate existing roads and construct new spur roads as needed to access areas selected for thinning.

**GUIDELINES:**
- Minimize length of new spur road construction. New spur roads will generally be less than 200' in length.
- Minimize cut and fill in spur road construction. Approximate pre-construction land contour in decommissioning.

**MITIGATION MEASURES:**
- Do not construct new permanent spur roads.
- Do not construct new spur roads within Riparian Reserves, and do not construct new stream crossings.
- Limit temporary spur road use to a single logging season and decommission spur roads at the end of the logging season (i.e., before the beginning of winter rains).
- Do not construct any new spur roads in stands >80 years old.
- Subsoil temporary roads upon completion of project as needed to reduce soil compaction.
- Block decommissioned roads to restrict vehicular access.

**OBJECTIVE: In stands treated under the above objectives, develop densities of shade-tolerant conifers to ensure that by age 81, they contain densities similar to those found in mature natural stands (26-90 TPA >2" dbh).**

**ACTION:** Within stands that are thinned to below 110 TPA at ages 21-30 and lack sufficient shade-tolerant conifer trees or seedlings to meet the objective, plant seedlings of shade-tolerant conifers (western hemlock, western red-cedar, grand fir, incense-cedar and/or Pacific yew) at densities of 26-200 trees per acre.

**ACTION:** Within stands that are thinned to below 80 TPA at ages 31-60 and lack sufficient shade-tolerant conifer trees or seedlings to meet the objective, plant seedlings of shade-tolerant conifers (western hemlock, western red-cedar, grand fir, incense-cedar and/or Pacific yew) at densities of 26-200 trees per acre.

**GUIDELINES:**

- Give preference in planting to areas with the greatest likelihood of seedling establishment and growth, considering factors such as post-thinning overstory density and shrub competition.
- Planting may be concentrated in distribution in response to site-specific conditions and need not be evenly distributed across the stand. Planting densities should generally be met at the scale of 10 acres (e.g., 260-2000 trees/10 acres).

**OBJECTIVE: In stands treated under the above objectives, develop quantities of snags and coarse woody debris to ensure that by age 81, they contain amounts consistent with Alternative #2 in the LSR Assessment (1102-3794 cu. ft./acre).**

**ACTION:** In thinned stands in which some cut trees are removed and coarse woody debris needs are not being met, leave sufficient felled trees as coarse woody debris to meet stand average coarse woody debris levels of at least 551 cu.ft./acre.

**GUIDELINES:**

- Coarse woody debris levels should be met at the approximate time of thinning operations.
- Coarse woody debris may be concentrated in distribution and need not be evenly distributed across the stand. Coarse woody debris levels should generally be met at the scale of 10 acres (e.g., 5510 cu.ft./10 acres). Individual coarse woody debris patches (i.e., areas in which all Douglas-fir trees are cut) should generally be limited to less than 1/4 acre in size.
- At least half of the volume of coarse woody debris target (i.e., 276 cu.ft./acre) should be from trees of diameters greater than the pre-treatment stand average diameter.

**ACTION:** In thinned stands in which some cut trees are removed and snag needs are not being met, create sufficient snags to meet stand average snag levels of at least 551 cu.ft./acre. Snags may be created by a variety of methods, including girdling, topping, blasting, and/or fungal inoculation.

**GUIDELINES:**

- Snag creation may be done at the time of thinning or delayed to allow time to assess natural tree mortality levels following thinning. Regardless, snag levels should be met within 5 years of the thinning operations, or within 10 years for stands thinned at ages 21-30 years.

- Snags may be concentrated in distribution and need not be evenly distributed across the stand. Snag levels should generally be met at the scale of 10 acres (e.g., 5510 cu.ft./10 acres). Individual snag patches (i.e., areas in which all Douglas-fir trees are killed) should generally be limited to less than 1/4 acre in size.
- At least half of the trees left for snags should have diameters greater than the pre-treatment stand average diameter.

## GOAL 3: Reconnect streams and reconnect stream channels to their riparian zones and upslope areas within LSR 267.

**OBJECTIVE: Decommission or improve all roads capable of delivering sediment to streams, as identified in watershed analysis within 10 years.**

**ACTION:** Decommission the roads shown in Appendix E.

**GUIDELINES:**

- Decommissioning may include any of the following measures:
  - discontinuing road maintenance;
  - tilling the road surface with dozer and subsoiler implement or a track mounted excavator;
  - removing gravel or pulling of gravel into the ditch line;
  - scarifying roads for creation of planting areas;
  - removing side cast soils from fill slopes with a high potential for triggering landslides;
  - filling and contouring of cut slope ditch lines to the adjacent hill slope;
  - removing culverts;
  - stabilizing stream crossings (e.g., recountering stream channels, placement of mulch or mats and seeding for erosion control, placement of rock and logs);
  - installing water bars, cross sloping or drainage dips to ensure adequate drainage into vegetated areas and away from streams or unstable road fills;
  - blocking the road using barricades, gating, or earth berm barriers;
  - placing slash, boulders, and/or woody debris on the road surface to deflect runoff, discourage OHV use, and promote vegetative growth;
  - seeding or planting for erosion control.
- Along roads being decommissioned, generally remove culverts and recontour stream channel to achieve streambank stability.

**ACTION:** On roads to be decommissioned, break up areas of soil compaction of the road surface (by subsoiling or other such methods) as needed to allow tree establishment and growth.

**GUIDELINES:**

- Where subsoiling or other such methods will not be sufficient to allow tree establishment and growth, recontour the road area to create better tree growing conditions.
- Coordinate thinning and coarse woody debris creation in adjacent stands to fall some trees across decommissioned roads to cover soil and block access.

**ACTION:** Plant trees or other native species on decommissioned road surface when needed to ensure tree establishment.

**ACTION:** Block decommissioned road as needed to restrict vehicular traffic.

**OBJECTIVE: On roads that will not be decommissioned, reduce the risk to the aquatic ecosystem attributable to the road network within 10 years.**

**ACTION:** Eliminate all barriers to movements of anadromous fish attributable to BLM-controlled roads.

**GUIDELINES:**

- Barriers may be eliminated by removal, replacement, or modification of culverts, and/or installation of downstream structures to raise upstream water levels within culverts or upstream structure to stabilize accumulated deposition.

**ACTION:** Develop and implement Memoranda of Understanding with adjacent road- and land-owners to eliminate barriers to movements of anadromous fish attributable to non-BLM roads or lands.

**ACTION:** Remove or replace culverts that have a high risk of failure.

**GUIDELINES:**

- Along roads that will not be decommissioned, replace existing culverts that are failed, undersized, or constitute passage barriers. An existing culvert may be replaced with another culvert, a half-arch or a bridge.
- For culverts creating a passage barrier, where removal or replacement are not feasible, access to the culvert may be created or improved by downstream log or boulder structure designed to elevate the stream channel and create pools to facilitate movement into the culvert. Downstream structures may also be used in conjunction with culvert replacement to improve passage.

**OBJECTIVE: Increase stream structure to >160 pieces/stream mile of woody debris (>6"diameter, 10' long) on all 1st and 2nd order streams adjacent to stands ≤80 years old, and >30 structures/stream mile along 3.8 miles of 3rd, 4th, or 5th-order streams within 10 years.**

**ACTION:** Construct woody debris structures with at least 3 key pieces/structure in 3rd, 4th, or 5th-order streams.

**GUIDELINES:**

- Key pieces should generally be greater than 50' long and ≥24" diameter.
- Cable or otherwise stabilize structures as needed in streams that are devoid of existing stable structure that has the potential to accumulate future woody debris recruitment.
- Consider yarding logs into the stream from nearby thinning operations.
- Wood imported from off-site (e.g., purchased logs or any other logs not from adjacent or nearby stands) should generally be used in structures on 4th and 5th-order streams.

**ACTION:** In riparian stands ≤80 years old that are not thinned under the thinning objective below, fall or pull over trees into the stream to increase levels to >160 pieces/stream mile of woody debris (>6"diameter, 10' long).

**GUIDELINES:**

- On streams with no existing woody debris, cut 160 trees >6" dbh/stream mile (approximately 25 trees/acre). If available, fall or pull trees to provide stable in-stream structure (generally 0.6 TPA ≥24"dbh).
- In conifer-dominated stands, generally select Douglas-fir for falling or pulling. In hardwood-dominated stands, generally select red alder and bigleaf maple for falling or cutting
- In conifer-dominated stands, generally do not fall or pull more than one tree/acre from the largest 10% of diameter classes in the stand.

- In hardwood-dominated stands, some conifers may be felled or pulled, but generally do not fall or pull more than half of the conifer trees (at the scale of one acre).
- Do not fall or pull conifers ≥32" dbh.
- Do not cut trees on immediate streambank that are contributing to streambank stability.

**OBJECTIVE: In 55% of riparian (<100' from stream) Douglas-fir stands 21-60 years old, attain conifer densities of ≥13 TPA ≥24" dbh by age 80.**

**ACTION:** Among stands aged 21 to 30 years, thin 75% of acres of Douglas-fir stands in riparian zone (i.e., <100' from streams) to a treated stand average of 60-110 Douglas-fir trees per acre.

**ACTION:** Among stands aged 31 to 50 years, thin 50% of acres of Douglas-fir stands in riparian zone (i.e., <100' from streams) to a treated stand average of 60-110 Douglas-fir trees per acre.

**ACTION:** Among stands aged 51 to 60 years, thin 25% of Douglas-fir stands in riparian zone (i.e., <100' from streams) to a treated stand average of 60-110 Douglas-fir trees per acre.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Thin from below: select the largest, most vigorous trees for retention within approximately even spacing to maximize individual tree growth.
- Generally leave all cut trees in the stand. Some removal may be needed to mitigate risk in limited locations, such as near roads.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.
- Generally limit the cutting of trees >12" dbh to lessen the risk of Douglas-fir bark beetle infestation. (Some trees >12" dbh will be specifically selected for snag and/or coarse woody debris creation). Where some cutting of trees >12" dbh would be needed to achieve target stand densities, lessen the risk of Douglas-fir bark beetle infestation by falling trees in the summer, removing some cut trees, or leaving part of the stand unthinned.
- Lessen fire risk from thinning by not creating high fuel loads near roads. Appropriate mitigations include measures such as removing cut trees from the stand; pulling-back cut trees from road edge; hand-piling and burning cut trees; or leaving part of the stand unthinned.

**OBJECTIVE: In 50% of riparian (<100' from stream) hardwood-dominated stands, attain conifer densities of 13 TPA 24"dbh by age 101-131 (or approximately 80 years after treatment).**

**ACTION:** Cut hardwoods and shrubs to provide growing space for conifers in hardwood-dominated stands in riparian zone (i.e., <100' from streams).

**GUIDELINES:**

- Cut or girdle competing hardwoods and shrubs to release existing conifer saplings or to create planting sites for conifers
- Select for cutting primarily red alder and tall shrubs, such as salmonberry, that compete aggressively with conifer saplings.
- Some trees may be girdled instead of cut to create snags.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.

**ACTION:** Plant conifer seedlings and/or saplings in hardwood-dominated stands that were treated under the previous action and lack sufficient conifers to meet objective densities.

**GUIDELINES:**

- Species planted will be primarily western red-cedar and Douglas-fir, but may also include western hemlock and grand fir, depending on specific site conditions.
- Give preference in planting to areas with the greatest likelihood of conifer establishment and growth, considering factors such as soil conditions, overstory density and shrub competition.
- Planting may be concentrated in distribution in response to site-specific conditions and need not be evenly distributed across the stand.
- Tube western red-cedar seedlings to reduce browsing.
- Control competing shrub vegetation by placing mats or mulch around the trees or by cutting competing shrubs at planting and during subsequent years as needed to establish trees.

# ALTERNATIVE E

## Reduce Stand Densities as Quickly as Possible

Achieve tree densities typical of late-successional forests as soon as possible regardless of short-term impacts

### GOAL 1: Protect and enhance late-successional and old-growth forest ecosystems.

**OBJECTIVE: On decommissioned and BLM-controlled roads, control noxious weeds within 10 years sufficient to ensure they do not penetrate into late-successional stands.**

**ACTION:** Inventory roads within or adjacent to late-successional stands for the presence of noxious weeds.

**ACTION:** Remove noxious weeds from BLM-controlled roads, including roads to be decommissioned.

**ACTION:** Plant trees or other native species in the decommissioned roads to prevent noxious weeds from becoming established in areas where weed seed is likely to spread into the decommissioned roads.

**GUIDELINE:**
- Use methods to remove weeds such as mowing, pulling, cutting and grubbing depending on the weed species.

**OBJECTIVE: Decommission non-shared, BLM-controlled roads in the next 10 years within or adjacent to late-successional stands.**

**ACTION:** Decommission the roads shown in Appendix E.

**GUIDELINE:**
- In determining the timing for decommissioning, consider whether the road would provide access for other management actions.

**ACTION:** Decommission unnumbered roads and non-designated trails as needed to protect and enhance late-successional forests.

**ACTION:** On roads to be decommissioned, break up areas of soil compaction of the road surface (by subsoiling or other such methods) as needed to allow tree establishment and growth.

**GUIDELINES:**
- Where subsoiling or other such methods will not be sufficient to allow tree establishment and growth, recontour the road area to create better tree growing conditions.
- Coordinate thinning and coarse woody debris creation in adjacent stands to fall some trees across decommissioned roads to cover soil and block access.

**ACTION:** Plant trees or other native species on the decommissioned road surface when needed to ensure tree establishment.

**ACTION:** Block decommissioned roads as needed to restrict vehicular traffic.

## GOAL 2: Foster the development of late-successional forest structure and composition in plantations and young forests within LSR 267.

**OBJECTIVE: Reduce tree density and increase variability of tree spacing in 90% (100% of stands; 90% of acres) of the 1-20-year age class, so that tree densities range from 31-46 TPA by age 21.**

**ACTION:** Thin stands aged 15 to 20 years to a stand average of 31-46 Douglas-fir trees per acre, with variable spacing.

**GUIDELINES:**
- Select only Douglas-fir for cutting.
- Select trees for retention based on random or highly variable spacing.
- Leave most or all cut trees in the stand.

**MITIGATION MEASURES:**
- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 10') of stands to restrict spread of noxious weeds.

**OBJECTIVE: Reduce tree density and increase variability of tree spacing in 75% (100% of stands; 75% of acres) of the 21-30-year age class, so that tree densities range from 31-46 TPA by age 31.**

**ACTION:** Thin stands aged 21 to 30 years to a treated stand average of 31-46 Douglas-fir trees per acre, with variable spacing.

**GUIDELINES:**
- Select only Douglas-fir for cutting.
- Select trees for retention based on random or highly variable spacing. Select trees amongst diameter classes approximately in proportion to their abundance.
- Leave in the stand any cut trees >16" dbh.
- Remove cut trees ≤16" dbh as necessary to reduce risk of fire or insect infestation. Some removal will generally be necessary in stands that have been pre-commercially thinned more than 8 years ago and are more than 23 years old.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**
- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.

- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 25') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**OBJECTIVE:** **Reduce tree density and increase variability of tree spacing in 75% (100% of stands; 75% of acres) of the 31-50-year age class, so that tree densities range from 31-46 TPA by age 51.**

**ACTION:** Thin stands aged 31 to 50 years to a treated stand average of 31-46 Douglas-fir trees per acre, with variable spacing.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Select trees for retention based on random or highly variable spacing. Select trees amongst diameter classes approximately in proportion to their abundance amongst diameter classes.
- Remove cut trees ≤20" dbh as necessary to reduce risk of fire or insect infestation. Some removal will generally be necessary.
- Do not harvest any trees >20" dbh felled for safety or operational reasons (though trees may be moved to provide coarse woody debris to other stands or streams).
- Retain existing snags and coarse woody debris, except for safety and operational reasons.
- Retain in the stand any snags felled for safety or operational reasons .
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.
- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 25') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.

**OBJECTIVE:** **Reduce tree density and increase variability of tree spacing in 25% (50% of stands; 50% of acres) of the 51-80-year age class, so that tree densities range from 31-46 TPA by age 81.**

**ACTION:** Thin stands aged 51 to 80 years to a treated stand average of 31-46 Douglas-fir trees per acre, with variable spacing.

**GUIDELINES:**

- Select only Douglas-fir for cutting.
- Select trees for retention based on a combination of thinning from below (i.e., cutting smaller diameter trees); proportional thinning amongst the larger diameter trees (cutting trees in approximate proportion to their abundance); and retention of the largest trees. This prescription will be expected to (1) cut most trees that are not expected to respond to increased growing space and (2) cut in a random or highly

variable pattern some of those trees that are expected to respond to increased growing space (e.g., trees with larger diameter, lower height:diameter ratio, greater percentage of live crown, etc.). Generally select for retention all of the largest 5% of the tree diameter distribution.

- Remove cut trees <20" dbh as necessary to reduce risk of fire or insect infestation. Some removal will generally be necessary.
- Do not harvest any trees >20" dbh felled for safety or operational reasons (though trees may be moved to provide coarse woody debris to other stands or streams).
- Retain existing snags and coarse woody debris of decay classes, except for safety and operational reasons.
- Retain in the stand any snags felled for safety or operational reasons.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.
- Generally avoid thinning within 1.5 miles of owl activity centers.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.
- Along areas (such as roadsides and adjacent clearcuts) with noxious weed problems, do not thin along edge (approximately 25') of stands to restrict spread of noxious weeds. Some tree cutting will be necessary to provide operational access.
- Evaluate stands ≥51 years old with older remnant trees for potential marbled murrelet habitat. Survey potential habitat or leave untreated.

**ACTION:** Construct new roads or renovate existing roads as needed to access areas identified as suitable for thinning.

**GUIDELINES:**

- Where new stream crossings are required, use temporary roads that are decommissioned after a single logging season.

**MITIGATION MEASURES:**

- Waterbar temporary roads between logging seasons.
- Subsoil temporary roads upon completion of project as needed to reduce soil compaction.
- Block decommissioned roads to restrict vehicular access.

**OBJECTIVE: In stands treated under the above objectives, develop densities of shade-tolerant conifers to ensure that by age 81, they contain densities similar to those found in mature natural stands (26-90 TPA >2" dbh).**

**ACTION:** Within thinned stands that lack sufficient shade-tolerant conifer trees or seedlings to meet the objective, plant seedlings of shade-tolerant conifers (western hemlock, western red-cedar, grand fir, incense-cedar and/or Pacific yew) at densities of 26-200 trees per acre.

**GUIDELINES:**

- Give preference in planting to areas with the greatest likelihood of seedling establishment and growth, considering factors such as post-thinning overstory density and shrub competition.
- Planting may be concentrated in distribution in response to site-specific conditions and need not be evenly distributed across the stand. Planting densities should generally be met at the scale of 10 acres (e.g., 260-2000 trees/10 acres).

**OBJECTIVE: In stands treated under the above objectives, develop quantities of snags and coarse woody debris to ensure that by age 81, they contain amounts consistent with Alternative #2 in the LSR Assessment (1102-3794 cu. ft./acre).**

**ACTION:** In thinned stands in which some cut trees are removed and coarse woody debris needs are not being met, leave sufficient felled trees as coarse woody debris to meet stand average coarse woody debris levels of at least 551 cu.ft./acre.

**GUIDELINES:**

- Coarse woody debris levels should be met at the approximate time of thinning operations.
- Coarse woody debris may be concentrated in distribution and need not be evenly distributed across the stand. Coarse woody debris levels should generally be met at the scale of 10 acres (e.g., 5510 cu.ft./10 acres). Individual coarse woody debris patches (i.e., areas in which all Douglas-fir trees are felled) should generally be limited to less than 1/4 acre in size.
- At least half of the volume of coarse woody debris target (i.e., 276 cu.ft./acre) should be from trees of diameters greater than the pre-treatment stand average diameter.

**ACTION:** In thinned stands in which some cut trees are removed and snag needs are not being met, create sufficient snags to meet stand average snag levels of at least 551 cu.ft./acre. Snags may be created by a variety of methods, including girdling, topping, blasting, and/or fungal inoculation.

**GUIDELINES:**

- Snag creation may be done at the time of thinning or delayed to allow time to assess natural tree mortality levels following thinning. Regardless, snag levels should be met within 5 years of the thinning operations.
- Snags may be concentrated in distribution and need not be evenly distributed across the stand. Snag levels should generally be met at the scale of 10 acres (e.g., 5510 cu.ft./10 acres). Individual snag patches (i.e., areas in which all Douglas-fir trees are killed) should generally be limited to less than 1/4 acre in size.
- At least half of the trees left for snags should have diameters greater than the pre-treatment stand average diameter.

## GOAL 3: Reconnect streams and reconnect stream channels to their riparian zones and upslope areas within LSR 267.

**OBJECTIVE: Decommission or improve all roads capable of delivering sediment to streams, as identified in watershed analysis within 10 years.**

**ACTION:** Decommission the roads shown in Appendix E.

**GUIDELINES:**

- Decommissioning may include any of the following measures:
- discontinuing road maintenance;
- tilling the road surface with dozer and subsoiler implement or a track mounted excavator;
    - removing gravel or pulling of gravel into the ditch line;
    - scarifying roads for creation of planting areas;
    - removing side cast soils from fill slopes with a high potential for triggering landslides;
    - filling and contouring of cut slope ditch lines to the adjacent hill slope;
    - removing culverts;
    - stabilizing stream crossings (e.g., recountering stream channels, placement of mulch or mats and seeding for erosion control, placement of rock and logs);
    - installing water bars, cross sloping or drainage dips to ensure adequate drainage into vegetated areas and away from streams or unstable road fills;
    - blocking the road using barricades, gating, or earth berm barriers;
    - placing slash, boulders, and/or woody debris on the road surface to deflect runoff, discourage OHV use, and promote vegetative growth;
    - seeding or planting for erosion control.
- Along roads being decommissioned, generally remove culverts and recontour stream channels to achieve streambank stability.

**ACTION:** On roads to be decommissioned, break up areas of soil compaction of the road surface (by subsoiling or other such methods) as needed to allow tree establishment and growth.

**GUIDELINES:**

- Where subsoiling or other such methods will not be sufficient to allow tree establishment and growth, recontour the road area to create better tree growing conditions.
- Coordinate thinning and coarse woody debris creation in adjacent stands to fall some trees across decommissioned roads to cover soil and block access.

**ACTION:** Plant trees or other native species on decommissioned road surface when needed to ensure tree establishment.

**ACTION:** Block decommissioned road as needed to restrict vehicular traffic.

**OBJECTIVE: On roads that will not be decommissioned, reduce the risk to the aquatic ecosystem attributable to the road network within 10 years.**

**ACTION:** Eliminate all barriers to movements of anadromous fish and aquatic organisms attributable to BLM-controlled roads.

**GUIDELINES:**

- Barriers may be eliminated by removal, replacement, or modification of culverts, and/or installation of downstream structures to raise upstream water levels within culverts or upstream structure to stabilize accumulated deposition.

**ACTION:** Develop and implement Memoranda of Understanding with adjacent road- and land-owners to eliminate barriers to movements of anadromous fish and other aquatic organisms attributable to non-BLM roads or lands.

**ACTION:** Remove or replace culverts that have a high risk of failure.

**GUIDELINES:**

- Along roads that will not be decommissioned, replace existing culverts that are failed, undersized, or constitute passage barriers. An existing culvert may be replaced with another culvert, a half-arch or a bridge.
- For culverts creating a passage barrier, where removal or replacement are not feasible, access to the culvert may be created or improved by downstream log or boulder structure designed to elevate the stream channel and create pools to facilitate movement into the culvert. Downstream structures may also be used in conjunction with culvert replacement to improve passage.

**OBJECTIVE: Increase stream structure to >160 pieces/stream mile of woody debris (>6"diameter, 10' long) on all streams adjacent to stands <80 years old, including>16 large pieces/stream mile (>24" diameter, 32' long)/mile on 5.8 miles of 3rd-order streams and larger within 10 years.**

**ACTION:** In riparian stands 80 years old that are not thinned under the thinning objectives, fall or pull over trees into the stream to increase levels to >160 pieces/stream mile of woody debris (>6"diameter, 10' long) including >16 large pieces/stream mile ( 24" diameter, 32' long)/stream mile on 3rd-order or larger streams.

**GUIDELINES:**

- On streams with no existing woody debris, cut 160 trees >6" dbh/stream mile (approximately 12-25 trees/acre) including>16 large pieces/stream mile (≥24" diameter, 32' long)/mile on 3rd-order or larger streams if available .
- Where sufficient trees are not available to increase levels to >16 large pieces/stream mile of woody debris (>24" diameter, 32' long) on 3rd-order or larger streams, bring logs from off-site and place in stream. Consider yarding logs into the stream from nearby thinning operations.
- In conifer-dominated stands, generally select Douglas-fir for falling or pulling. In hardwood-dominated stands, generally select red alder and bigleaf maple for falling or cutting
- In conifer-dominated stands, generally do not fall or pull more than one tree/acre from the largest 10% of diameter classes in the stand.
- In hardwood-dominated stands, some conifers may be felled or pulled, but generally do not fall or pull more than half of the conifer trees (at the scale of one acre).
- Do not cut trees on immediate streambank that are contributing to streambank stability.

**OBJECTIVE: In 75% (100% of stands; 75% of acres) of riparian (<100' from stream) hardwood-dominated stands, attain conifer densities of 19-51 TPA free-to-grow (i.e., conifer heights at or above hardwood canopy level) by age 81.**

**ACTION:** Cut hardwoods and shrubs to provide growing space for conifers in hardwood-dominated stands in riparian zone (i.e., <100' from streams).

**GUIDELINES:**

- Cut or girdle competing hardwoods and shrubs to release existing conifer saplings or to create planting sites for conifers
- Select for cutting primarily red alder and tall shrubs, such as salmonberry, that compete aggressively with conifer saplings.
- Some trees may be girdled instead of cut to create snags.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.

**ACTION:** Plant conifer seedlings and/or saplings in hardwood-dominated stands that were treated under the previous action and lack sufficient conifers to meet objective densities.

**GUIDELINES:**

- Species planted will be primarily western red-cedar and Douglas-fir, but may also include western hemlock and grand fir, depending on specific site conditions.
- Give preference in planting to areas with the greatest likelihood of conifer establishment and growth, considering factors such as soil conditions, overstory density and shrub competition.
- Planting may be concentrated in distribution in response to site-specific conditions and need not be evenly distributed across the stand.
- Tube western red-cedar seedlings to reduce browsing.
- Control competing shrub vegetation by placing mats or mulch around the trees or by cutting competing shrubs at planting and during subsequent years as needed to establish trees.

# ALTERNATIVE F

## Multi-Entry and Multi-Trajectory Thinning

Maintain stand vigor by increasing growing space, developing wind firmness, and maintaining crown development, while maintaining canopy closure

### GOAL 1: Protect and enhance late-successional and old-growth forest ecosystems.

**OBJECTIVE: On decommissioned and BLM-controlled roads, control noxious weeds within 10 years sufficient to ensure they do not penetrate into late-successional stands.**

**ACTION:** Inventory roads within or adjacent to late-successional stands for the presence of noxious weeds.

**ACTION:** Remove noxious weeds from BLM-controlled roads, including roads to be decommissioned.

**ACTION:** Plant trees or other native species in the decommissioned roads to prevent noxious weeds from becoming established in areas where weed seed is likely to spread into the decommissioned roads.

**GUIDELINE:**
- Use methods to remove weeds such as mowing, pulling, cutting and grubbing depending on the weed species.

**OBJECTIVE: Decommission or close and stabilize non-shared, BLM-controlled roads that (1) are capable of delivering sediment to streams, (2) are damaged and not needed for future access, or (3) dead-end in late-successional stands.**

**ACTION:** Decommission the roads shown in Appendix E.

**GUIDELINE:**
- In determining the timing for decommissioning, consider whether the road would provide access for other management actions.

**ACTION:** Decommission unnumbered roads and non-designated trails as needed to protect and enhance late-successional forests.

**ACTION:** On roads to be decommissioned, break up areas of soil compaction of the road surface (by subsoiling or other such methods) as needed to allow tree establishment and growth.

**GUIDELINES:**
- Where subsoiling or other such methods will not be sufficient to allow tree establishment and growth, recontour the road area to create better tree growing conditions.

Coordinate thinning and coarse woody debris creation in adjacent stands to fall some trees across decommissioned roads to cover soil and block access.

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**ACTION:** Plant trees or other native species on the decommissioned road surface when needed to ensure tree establishment.

**ACTION:** Block decommissioned roads as needed to restrict vehicular traffic.

## GOAL 2: Foster the development of late-successional forest structure and composition in plantations and young forests within LSR 267.

**OBJECTIVE: Reduce tree density in 90% of the 10-24-year age class so that tree densities range from 105-250 TPA by age 25.**

**ACTION:** Thin 27% of stands aged 10-24 years old that have not been pre-commercially thinned or that have more than 220 well-spaced trees per acre to 105-150 TPA.

**ACTION:** Thin 25% of stands aged 10-24 years old that have not been pre-commercially thinned or that have more than 220 well-spaced trees per acre to 135-220 TPA.

**ACTION:** Thin 13% of stands aged 10-24 years old that have not been pre-commercially thinned or that have more than 250 well-spaced trees per acre to 150-250 TPA.

**ACTION:** Thin 25% of stands aged 10-24 years old that have not been pre-commercially thinned or that have more than 250 well-spaced trees per acre to 165-240 TPA.

**GUIDELINES:**

- Select the largest, most vigorous trees for retention within overall even spacing.
- Leave most or all cut trees in the stand.
- Retain most minor conifers (i.e., western hemlock, western red-cedar, grand fir, and incense-cedar) as part of the overall conifer spacing, giving greater preference to minor conifers when they are more scarce.
- Retain most larger hardwoods (typically retain hardwoods >12" dbh).
- Generally avoid thinning within 10' of perennial streams.

**OBJECTIVE: Reduce tree density in 47% of the 25-39-year age class, so that tree densities range from 60-135 TPA by age 40.**

**ACTION:** Thin 7% of stands aged 25 to 39 years old that have more than 150 well-spaced trees per acre to 60-75 TPA.

**ACTION:** Thin 7% of stands aged 25 to 39 years old that have more than 150 well-spaced trees per acre to 60-105 TPA.

**ACTION:** Thin 7% of stands aged 25 to 39 years old that have more than 250 well-spaced trees per acre to 75-125 TPA.

**ACTION:** Thin 13% of stands aged 25 to 39 years old that have more than 150 well-spaced trees per acre to 80-125 TPA.

**ACTION:** Thin 13% of stands aged 25 to 39 years old that have more than 210 well-spaced trees per acre to 90-135 TPA.

**GUIDELINES:**

- Thin from below: select the largest, most vigorous trees for retention.
- Retain most minor conifers (e.g., western hemlock, western red-cedar, grand fir, and incense-cedar) and hardwoods.
- Generally use the higher density prescriptions (i.e., >75 TPA) within 50' of streams.
- Remove cut trees as necessary to reduce risk of fire or insect infestation. Some removal will generally be necessary.
- Retain existing snags and coarse woody debris of decay classes 3, 4, and 5, except for safety or operational reasons.
- Retain in the stand any snags felled for safety or operational reasons.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling or pulling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.

**OBJECTIVE:** **Reduce tree density in 24% of the 40-80-year age class, so that tree densities range from 35-105 TPA by age 81.**

**ACTION:** Thin 4% stands aged 40 to 80 years that have less than 210 trees per acre to a treated stand average of 35-55 trees per acre.

**ACTION:** Thin 4% stands aged 40 to 80 years that have less than 210 trees per acre to a treated stand average of 55-65 trees per acre.

**ACTION:** Thin 4% stands aged 40 to 80 years that have less than 210 trees per acre to a treated stand average of 55-75 trees per acre.

**ACTION:** Thin 6% stands aged 40 to 80 years that have less than 210 trees per acre to a treated stand average of 65-85 trees per acre.

**ACTION:** Thin 6% stands aged 40 to 80 years that have less than 210 trees per acre to a treated stand average of 65-105 trees per acre.

**GUIDELINES:**

- Thin from below: select the largest, most vigorous trees for retention.
- Retain most minor conifers (e.g., western hemlock, western red-cedar, grand fir, and incense-cedar) and hardwoods.
- Maintain >55 TPA within 100' of streams.
- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Remove cut trees as necessary to reduce risk of fire or insect infestation. Some removal will generally be necessary, except do not remove trees cut within 25' of streams or felled to within 25' of streams.
- Retain existing snags and coarse woody debris of decay classes 3, 4, and 5, except for safety or operational reasons.
- Retain in the stand any snags felled for safety or operational reasons.
- Target stand densities should be reached after completion of coarse woody debris and snag creation done under objectives below.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling or pulling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.
- Evaluate stands ≥51 years old with older remnant trees for potential marbled murrelet habitat. Survey potential habitat or leave untreated.

**ACTION:** Construct new roads or renovate existing roads as needed to access areas identified as suitable for thinning.

**GUIDELINES:**

- Generally construct only temporary roads.

**MITIGATION MEASURES:**

- Do not build new roads in stands >80 years old.
- Waterbar temporary roads between logging seasons.
- Decommission roads upon completion of final stand thinning.
- Block decommissioned roads to restrict vehicular access.

**OBJECTIVE: In stands treated under the above objectives, develop densities of shade-tolerant conifers to ensure that by age 81, they contain densities similar to those found in mature natural stands (26-90 TPA >2" dbh).**

**ACTION:** Within thinned stands that lack sufficient shade-tolerant conifer trees or seedlings to meet the objective, plant seedlings of shade-tolerant conifers (western hemlock, western red-cedar, grand fir, incense-cedar and/or Pacific yew) at densities of 26-200 trees per acre.

**GUIDELINES:**

- Give preference in planting to areas with the greatest likelihood of seedling establishment and growth, considering factors such as post-thinning overstory density and shrub competition.
- Planting may be concentrated in distribution in response to site-specific conditions and need not be evenly distributed across the stand. Planting densities should generally be met at the scale of 10 acres (e.g., 260-2000 trees/10 acres).

**OBJECTIVE: In stands treated under the above objectives, develop quantities of snags and coarse woody debris to ensure that by age 81, they contain amounts consistent with Alternative #3 in the LSR Assessment (525-2844 cu. ft./acre).**

**ACTION:** Cut and leave 3-15 Douglas-fir trees per acre as coarse woody debris (approximately 100-500 cu.ft./acre) in stands thinned at ages 40-80 in which coarse woody debris needs are not being met.

**ACTION:** Create snags by killing 1-3 Douglas-fir trees per acre (approximately 30-100 cu.ft./acre) in stands thinned at ages 40-80 in which snag needs are not being met. Snags may be created by a variety of methods, including girdling, topping, blasting, and/or fungal inoculation.

**GUIDELINES:**

- Snag and coarse woody debris creation may be done at the time of thinning or delayed to allow time to assess natural tree mortality levels following thinning. Regardless, snag and coarse woody debris levels should be met within 10 years of the thinning operations.
- Coarse woody debris and snags may be concentrated in distribution and need not be evenly distributed across the stand. Coarse woody debris and snag levels should generally be met at the scale of 10 acres. Individual coarse woody debris and snag patches (i.e., areas in which all Douglas-fir trees are cut or killed) should generally be limited to less than 1/4 acre in size.

## GOAL 3: Reconnect streams and reconnect stream channels to their riparian zones and upslope areas within LSR 267.

**OBJECTIVE: Decommission or improve all roads capable of delivering sediment to streams, as identified in watershed analysis within 10 years.**

**ACTION:** Decommission the roads shown in Appendix E.

**GUIDELINES:**

- Decommissioning may include any of the following measures:
  - discontinuing road maintenance;
  - tilling the road surface with dozer and subsoiler implement or a track mounted excavator;
  - removing gravel or pulling of gravel into the ditch line;
  - scarifying roads for creation of planting areas;
  - removing side cast soils from fill slopes with a high potential for triggering landslides;
  - filling and contouring of cut slope ditch lines to the adjacent hill slope;
  - removing culverts;
  - stabilizing stream crossings (e.g., recountering stream channels, placement of mulch or mats and seeding for erosion control, placement of rock and logs);
  - installing water bars, cross sloping or drainage dips to ensure adequate drainage into vegetated areas and away from streams or unstable road fills;
  - blocking the road using barricades, gating, or earth berm barriers;
  - placing slash, boulders, and/or woody debris on the road surface to deflect runoff, discourage OHV use, and promote vegetative growth;
  - seeding or planting for erosion control.
- Along roads being decommissioned, generally remove culverts and recontour stream channels to achieve streambank stability.

**ACTION:** On roads to be decommissioned, break up areas of soil compaction of the road surface (by subsoiling or other such methods) as needed to allow tree establishment and growth.

**GUIDELINES:**

- Where subsoiling or other such methods will not be sufficient to allow tree establishment and growth, recontour the road area to create better tree growing conditions.

- Coordinate thinning and coarse woody debris creation in adjacent stands to fall some trees across decommissioned roads to cover soil and block access.

**ACTION:** Plant trees or other native species on decommissioned road surface when needed to ensure tree establishment.

**ACTION:** Block decommissioned road as needed to restrict vehicular traffic.

**OBJECTIVE: On roads that will not be decommissioned, reduce the risk to the aquatic ecosystem attributable to the road network within 10 years.**

**ACTION:** Eliminate all barriers to movements of anadromous fish and aquatic organisms attributable to BLM-controlled roads.

**GUIDELINES:**

- Barriers may be eliminated by removal, replacement, or modification of culverts, and/or installation of downstream structures to raise upstream water levels within culverts or upstream structure to stabilize accumulated deposition.

**ACTION:** Develop and implement Memoranda of Understanding with adjacent road- and land-owners to eliminate barriers to movements of anadromous fish and other aquatic organisms attributable to non-BLM roads or lands.

**ACTION:** Remove or replace culverts that have a high risk of failure.

**GUIDELINES:**

- Along roads that will not be decommissioned, replace existing culverts that are failed, undersized, or constitute passage barriers. An existing culvert may be replaced with another culvert, a half-arch or a bridge.
- For culverts creating a passage barrier, where removal or replacement are not feasible, access to the culvert may be created or improved by downstream log or boulder structure designed to elevate the stream channel and create pools to facilitate movement into the culvert. Downstream structures may also be used in conjunction with culvert replacement to improve passage.

**OBJECTIVE: Increase stream structure to 56 structures/stream mile along 3.8 miles of streams within 10 years.**

**ACTION:** Construct woody debris structures with at least 3 key pieces/structure in 3rd, 4th, or 5th-order streams.

**GUIDELINES:**

- Key pieces should generally be greater than 50' long and ≥24"diameter.
- Cable or otherwise stabilize structures as needed in streams that are devoid of existing stable structure that has the potential to accumulate future woody debris recruitment.
- Wood imported from off-site (e.g., purchased logs or any other logs not from adjacent or nearby stands) should generally be used in structures on 4th and 5th-order streams.

**OBJECTIVE: In 50% of riparian (<100' from stream) hardwood-dominated stands, attain conifer densities of ≥13 TPA ≥24"dbh by age 101-131 (or approximately 80 years after treatment).**

**ACTION:** Cut hardwoods and shrubs to provide growing space for conifers in hardwood-dominated stands in riparian zone (i.e., <100' from streams).

**GUIDELINES:**

- Cut or girdle competing hardwoods and shrubs to release existing conifer saplings or to create planting sites for conifers
- Select for cutting primarily red alder and tall shrubs, such as salmonberry, that compete aggressively with conifer saplings.
- Some trees may be girdled instead of cut to create snags.

**MITIGATION MEASURES:**

- Do not cut trees on immediate streambank that are contributing to streambank stability.
- Limit falling or pulling of trees directly into streams to approximately 160 trees per stream mile (though this average quantity would likely be very unevenly distributed along any particular stream reach).
- Avoid creating large concentration of fallen trees with intact needles or leaves in stream reaches with poor oxygen reaeration (e.g., high water temperatures, low stream gradient, very slow moving water) during seasons of low stream flow (summer and early fall).
- Maintain sufficient stream shading so as to avoid contributing to increased water temperature.

**ACTION:** Plant conifer seedlings and/or saplings in hardwood-dominated stands that were treated under the previous action and lack sufficient conifers to meet objective densities.

**GUIDELINES:**

- Species planted will be primarily western red-cedar and Douglas-fir, but may also include western hemlock and grand fir, depending on specific site conditions.
- Give preference in planting to areas with the greatest likelihood of conifer establishment and growth, considering factors such as soil conditions, overstory density and shrub competition.
- Planting may be concentrated in distribution in response to site-specific conditions and need not be evenly distributed across the stand.
- Tube western red-cedar seedlings to reduce browsing.
- Control competing shrub vegetation by placing mats or mulch around the trees or by cutting competing shrubs at planting and during subsequent years as needed to establish trees.

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# APPENDIX B
# Forest Modeling And The Landscape Management System (LMS)

## Introduction

In order to evaluate the consequences of silvicultural actions, we projected the forest landscape forward in time. We had to strike a balance between the precision of the modeling and the scope of the analysis, because of the large size of the landscape, the variety of conditions existing upon that landscape, and the variety of treatments analyzed. For each step in the modeling, we invoked simplifying assumptions to prevent the analysis from expanding beyond a manageable size.

The major steps in the modeling include:

- establishing the starting condition;
- developing the treatment pathways;
- projecting the landscape forward in time using a stand growth model;
- summarizing the results across the landscape; and
- evaluating the results against criteria.

## Establishment of the Starting Condition

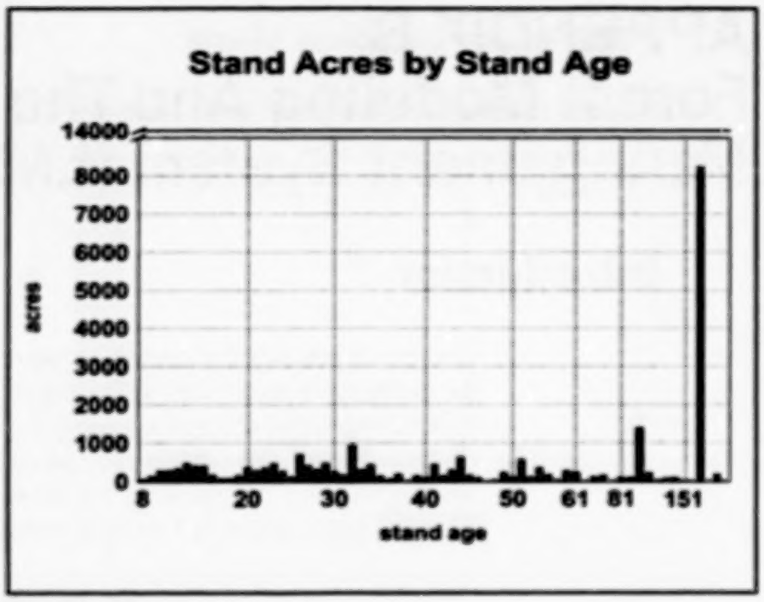
### Available Data

The Eugene District maintains a Geographic Information System (GIS) which, along with the Forest Operations Inventory (FOI), identifies the location and attributes such as age and stand type for each stand in the planning area. The District also maintains the MICRO*STORMS data base, which records the treatment history for all managed stands. These three geographically-based systems are connected through a unique number – the FOI polygon number – which identifies each forest stand. This FOI polygon number and the attributes ascribed to it form the basis of all summary numbers, such as acres of an age-class, acres which have been planted, etc. The starting acres and later stratifications of these acres are all calculated from summaries or intersections of these polygons with various GIS themes, such as stream or road locations.

In addition to these main data systems which are used to develop the landscape application of the silvicultural treatments, various other data exist to assist in the analysis. We used stand exam data, post-pre-commercial thinning exams, stocking exams, and timber sale cruise data to calibrate the analysis at various points.

### Stratification

Once the FOI polygons and their acres were compiled by stand birthdate and treatment history (see Graph 45), we stratified the landscape into a series of 15 "type stands": a generalized stand condition for a given age class and its typical management history. These type stands are surrogates for a group of age classes or birthdates. Reduction of the multitude of stand ages into a smaller set of type stands keeps the application of the treatments to a manageable size. The type stands selected for this analysis are shown in Table 9. We selected the type stands specifically to narrow the groups for which stands are in a state of rapid structural change. In managed Douglas-fir stands from about 20-60 years of age, tree diameters and heights change dramatically, and stands typically undergo extensive density-dependent mortality ("self-thinning").



**Graph 45**

We modeled stands >80 years of age, which are not proposed for treatment, with only 3 type stands, despite the wide variety of conditions present in older stands. The analysis assumes that these older stands have already attained late-successional forest structure and will change slowly over the analysis period.

### Table 9. Type Stand Groupings

| Type name | Ages represented | Acres represented | Average age (wtd mean) | Average age (mode) |
|---|---|---|---|---|
| DF 10 | 8-9 | 191 | 9 | 9 |
| DF15 non-pct | 10-14 | 662 | 12 | 13 |
| DF 15 pct | 10-14 | 1118 | 12 | 14 |
| DF 20 | 15-19 | 888 | 16 | 15 |
| DF 25 | 20-24 | 1759 | 22 | 23 |
| DF 30 | 25-29 | 2043 | 27 | 26 |
| DF 35 | 30-35 | 2304 | 32 | 32 |
| DF 40 non-pct | 36-42 | 718 | 39 | 41 |
| DF 40 pct | 36-42 | 413 | 39 | 41 |
| DF 45 | 43-49 | 1496 | 44 | 44 |
| DF 55 | 50-59 | 1688 | 53 | 51 |
| DF 65 | 61-66 | 376 | 63 | 61 |
| DF 75 | 71-76 | 170 | 71 | 71 |
| DF 95 | 81-111 | 1838 | 101 | 101 |
| DF 135 | 121-151 | 261 | 135 | 141 |
| OG 150 | 152+ | 8442 | 191 | 191 |

DF=Douglas fir
OG = Old Growth
pct = pre-commercially thinned
non-pct = not pre-commercially thinned

Finally, we split all type stands into 2 subgroups: uplands and riparian areas (<100' from streams). Riparian areas were identified based on the Eugene District Hydrological GIS theme. Splitting FOI polygons into upland and riparian stands allowed the modeling of different treatment prescriptions in upland and riparian areas.

### Starting inventories

We developed starting stand inventories for type stands ≤80 years old using the FVS stand modeler and the typical stand treatment histories. We averaged stand age within the range of the stand type (see Table 9) and assumed the treatment history to be that which was predominant at the time, from the MICRO*STORMS database. We assumed that stands were pre-commercially thinned, with the following exceptions. The DF10 (i.e., 10-year old type stand) has not yet been pre-commercially thinned. We split the DF15 into pre-commercially thinned and non-pre-commercially thinned stands to reflect that pre-commercial thinning is currently underway in this age class. We split the DF40 into pre-commercially thinned and non-pre-commercially thinned stands because a substantial portion of stands in that age-class were not pre-commercial thinned because of inadequate funding.

We developed starting stand inventories for type stands >80 years old from timber cruise data and the FVS stand modeler.

The stands 80 years old in the planning area are generally high density, uniform in structure, and dominated by Douglas-fir. Although hardwood stands are present in the planning area, they are generally confined to the immediate riparian areas of larger streams and comprise less than 4% of all typed stands. Simplifying this forest landscape into a series of 15 type stands with a single starting inventory for each type stand permits the modeling of change to forests over time across a large landscape under multiple alternatives.

The starting stand inventories we used appear to slightly underestimate tree diameter and height. BLM is currently conducting a series of stand examinations in and near the planning area, to evaluate the starting stand inventories.

## Development of the Silvicultural Pathways

For each alternative, we developed silvicultural pathways which applied the treatments to appropriate type stands. These silvicultural pathways include both treatments within the 10-year plan period, and subsequent treatments which would occur until the stands are >80 years old. See Figure 1 for an example of a treatment pathway. Treatments include thinning, underplanting, falling trees for course woody debris, and killing trees for snags.

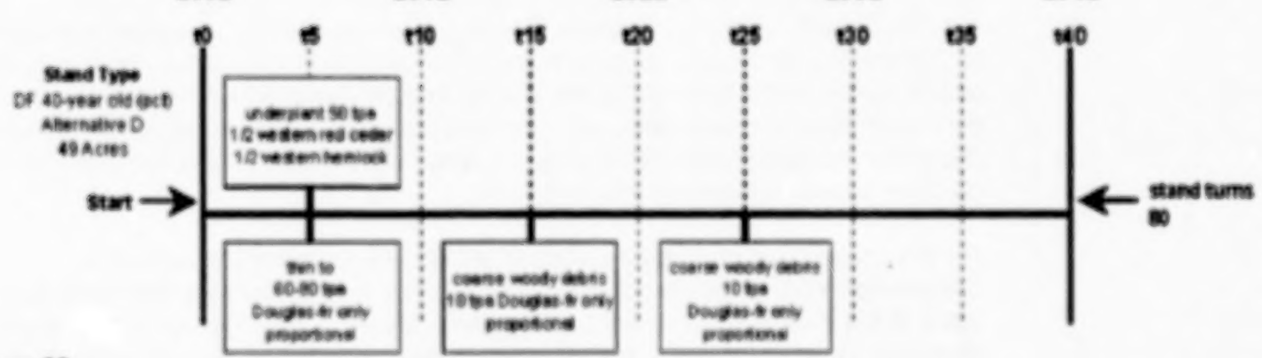


Figure 63

A number of simplifying assumptions were necessary to prevent an unmanageable proliferation of pathways. First, we averaged thinning prescriptions that specified a range of tree densities (e.g., 50 - 70 TPA was modeled as 60 TPA). Second, we applied treatments at no less than 5-year intervals, which coincides with the minimum time increment of the stand model. Third, the analysis assumes that there would be no natural establishment of new trees. Fourth, the analysis does not provide for natural disturbance events, such as fires or windstorms.

There are two important limitations of the modeling with regard to the silvicultural pathways. First, the model applies thinning evenly at the indicated density, even though several alternatives in the analysis specify variable spacing. There are no comparable stand models available which can model thinning in a spatially explicit manner. Therefore the changes in point-to-point density in spatially variable treatments have to be inferred from the overall stand data. Second, the model does not include hardwoods. Bigleaf maple in particular is likely to be an important component of stands in the planning areas under many of the treatments. However, the development of bigleaf maple within Douglas-fir stands in this planning area is likely to approximate the development of western hemlock, which can function as a surrogate for bigleaf maple development in the modeling results.

# Projection of the Landscape

This analysis uses the Landscape Management System (LMS) to project the initial starting conditions through the silvicultural pathways into the future. LMS is being developed as part of the Landscape Management Project at the Silviculture Laboratory, College of Forest Resources, University of Washington. The LMS model itself and additional information about LMS is available online at http://lms.cfr.washington.edu/lms.html. LMS is an assemblage of programs and interfaces, in which the user enters starting inventories, selects a growth model, enters the silvicultural pathways into a scenario, and establishes an analytical period. LMS supports a number of variants of the U.S. Forest Service Forest Vegetation Simulator (FVS) and the BLM Organon growth simulator. For this analysis, we selected the Western Cascade variant of FVS.

The minimum time increment used for the modeling in this analysis is 5 years, with 20 total increments (including time 0). As a result, the overall analysis period is 95 years, which is approximated to 100 years in the effects analysis. The analysis defines the year 2002 as time 0: the beginning of the analysis period. Although a longer analytical period might have revealed additional development of late-successional characteristics, especially among the youngest stands, it was too difficult to evaluate the reliability of the growth model or calibrate the results against empirical data beyond 100 years.

LMS, and the FVS model within it, are coupled to an output interface which prepares stand-level information such as relative density, basal area, quadratic mean diameter, and other commonly used stand-level statistics. In addition, the user can access individual stand inventory projections. These outputs can then be compared to empirical data to confirm the models projections and allow calibration through adjustments to the growth model. In the FVS model, this is done through use of a keyfile which modifies the growth rates, mortality rates, etc. The LMS program also interfaces to the embedded Stand Visualization System (SVS) program, which provides a visualization of the stand condition based on the stand inventory data.

For this analysis, we conducted a number of trial runs using the LMS program. Comparing modeling results with local, empirical stand data indicated that the default levels of the FVS program were allowing growth rates that were too high at high stand densities. In particular, stand relative densities were maintained at levels higher than generally observed in real stands: many trajectories reached relative densities of 90. Therefore, the model was calibrated by reducing the maximum level the Stand Density Index by 10%. This lowered the maximum allowable stand density and increased mortality levels as stands approached high densities. The maximum allowable stand basal area was also reduced to 350 square feet/acre, which also slowed growth at very high stand densities. These changes improved the performance of the model, causing the relative densities of the stands to limit out between 55 and 65, between the zone of imminent mortality and "normality" – the maximum density usually seen in natural stands. Also, the modeled stands were very similar to empirical data on similar-aged, single-cohort natural stands in volume, basal area, trees per acre, quadratic mean diameter, and relative density. This favorable comparison suggests that the model is performing satisfactorily for the untreated stands, though perhaps still slightly overestimating growth rates in high density stands.

We made two changes to the default LMS output metrics, which improved our ability to evaluate the results against current research and the existing watershed analysis and LSR Assessment. First, the default metric for height:diameter ratio measured the average height:diameter ratio of the biggest 100 trees. Many of the proposed treatments would lower overstory density well below 100 TPA, which allowed small, underplanted trees to skew the overall stand height:diameter ratio. Therefore, we changed this measurement to the average height:diameter ratio of all Douglas-fir trees >2" dbh, eliminating the effect of underplanted seedlings. Second, the default metric for canopy cover excluded canopy contribution of overlapping tree crowns, which grossly underestimated canopy cover percentages for moderate stand densities compared to local experience and the estimate in the LSR Assessment (p. 40). We changed this measurement to count the contribution of overlapping crowns to canopy cover. This method still appears to underestimate canopy cover at moderate stand densities, but is within approximately 10% of expected values. This continuing slight underestimation of canopy cover may be resulting from the model slightly underestimating mean crown width, which we will calibrate if necessary based on the results of ongoing stand examinations. Note that this method allows the canopy cover in high density stands to exceed 100% because of the contribution of overlapping crowns.

## Summarizing the Results Across the Landscape

The fundamental unit of the stand projection model in LMS is one acre. The Toggle Program, an adjunct to LMS, was used to expand these one-acre projections to the landscape level. The Toggle Program takes the outputs from LMS, adds up the available acreage for each pathway, and summarizes the conditions across the landscape.

## Evaluation of Results

The results tabulated for the projections across the landscape were compared against thresholds for various issues in the analysis, such as late-successional forest structural characteristics, marbled murrelet habitat, and northern spotted owl habitat. The Toggle Program queries the output of LMS and determines which pathways and which acres meet the thresholds over time. For this analysis, those stands >80 years old at the beginning of the analysis period were removed from the modeling and presumed to have late-successional forest structure. Therefore, acres of stands currently >80 years old constitutes a base acreage to which additional acres are added as stands currently 80 years old acquire late-successional forest structure over time. The graphs and tables in the analysis reflect only the additional acres of stands currently ≤80 years old that acquire late-successional forest structure over time, and not the base acreage of stands currently >80 years old.

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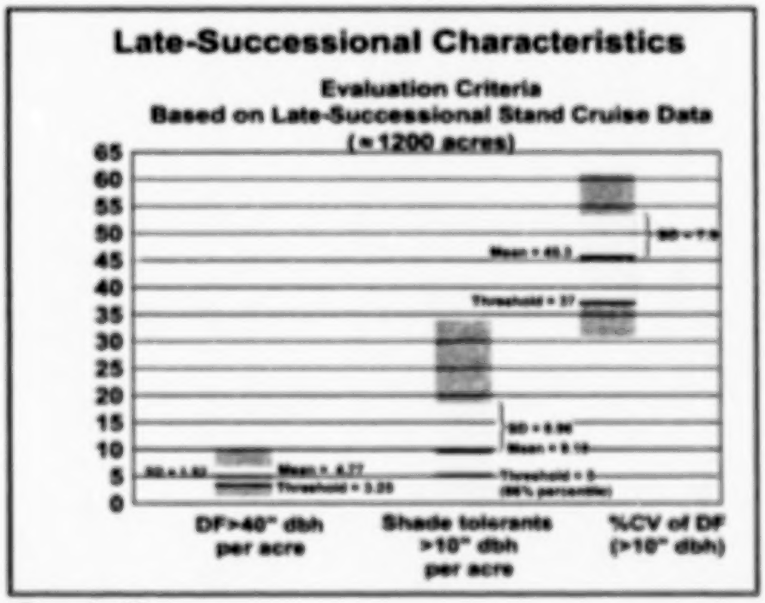
# APPENDIX C
# Local Late-successional Forest Characteristics

We evaluated regional averages for late-successional forest characteristics (Spies and Franklin 1988; Spies and Franklin 1991; LSR Assessment, p. 57) against local data. A recent study of BLM timber cruise data for timber sales in the late 1980s and early 1990s in the Eugene and Salem Districts evaluated late-successional forest characteristics (Poage 2001). That data set consists of 91 timber sales or sale units for which the electronic data on the sale were still available. That data set comprises a precise and accurate sample of the population of trees in sale areas of approximately 20-100 acres. We examined that data set to derive the evaluation criteria for late-successional forest structural characteristics. We extracted the portion of the data set which describes sales in the Coast Range within the Eugene District. This subset totals 1,295 acres of stand data, constituting 24 sales or sale units.

From this sub-set of the Poage data set, we calculated the mean values and standard deviations of the parameters selected: density of very large Douglas-fir (>40" dbh), density of shade-tolerant conifers (>10" dbh), and Coefficient of Variation (CV) of Douglas-fir diameters (>10" dbh). For most of these characteristics, we selected a threshold from the mean value minus one standard deviation. However, for the density of shade-tolerant conifers, the standard deviation exceeds the mean value, which appears to be a consistent pattern throughout the larger data set as well (Poage 2001, p. 35). For shade-tolerant conifers, we selected the threshold from the 66th percentile of sample values. In addition, if both the CV of diameter and the shade-tolerant levels were met, the diameter was relaxed to 32" dbh. Both of these methods of selecting the thresholds were intended to establish a threshold that represented the structural conditions of most late-successional forests, but not necessarily absolute minimum conditions found in all late-successional forests.

In addition, we have compiled a larger data set of over 4,000 acres, limited to sales within or immediately near the planning area. This data set from the timber sale summaries is not as detailed or precise: it does not provides descriptions of all trees by sizes, but just by density levels of species at the overall timber sale level, which typically contained 1-6 sale units. This data set confirms the applicability of the Poage data set by comparing the overall density parameters to similar summaries of the Poage data set. We are currently enlarging the more precise data set by adding additional sales from within or immediately near the planning area. Data similar to the Poage data set is being reconstructed from the timber cruise records.



Graph 46

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Examination of this data set, which is limited to the planning area or immediate surrounding lands, will allow us to evaluate the applicability of the late-successional forest structural characteristics used in this analysis and might lead to refinement of the threshold levels. Although this more local data set is not yet fully compiled, preliminary examination suggests that it is substantially similar to the Poage data set and will not lead to any substantial modifications of the late-successional forest structural characteristic thresholds in this analysis.

# APPENDIX D
# Sedimentation Analysis Methodology

## Introduction

Sedimentation occurring from forest practices within the planning area includes chronic delivery from road surface erosion, episodic delivery from landslides as a result of culvert failures during storm events, and temporary pulses of sediment during fish passage improvement projects, in-stream restoration projects, and new road construction. The intent of the quantification of sedimentation is to evaluate the relative contribution of sediment that could potentially occur from each activity under the different alternatives.

### Road Surface Erosion

The analysis of road-related sedimentation here differs slightly from the analysis in the Siuslaw Watershed Analysis because of refinements made to the modeling assumptions, made in part in response to the findings of the 2002 road inventory.

We estimated fine sediment delivery to the stream system by field observations as part of the 2002 road inventory, in which we inventoried all BLM-controlled roads in the planning area. For purposes of calculating sedimentation, only road segments capable of delivering sediment to stream systems were identified for this analysis. Of the total 65.96 miles of road inventoried, 24.84 miles are capable of contributing sediment to streams. Using the Washington Standard Methodology for Conducting Watershed Analysis (WFPB 1995), we examined road segments for road prism characteristics and drainage deliverability. We applied factors for differing conditions of the road tread, cut and fill slopes, and traffic use. This analysis assumes average conditions: prism widths of cut slope (15'), tread (9') and fill slope (10'). Because factors used in the Washington methodology were based on a combination of studies performed in the Idaho Batholith area and elsewhere, we made one deviation to the traffic factor to more accurately reflect the lithology of the planning area.

Deviation: We calibrated the deviation in the traffic factor for this analysis from unpublished research performed in southwestern Washington (Mack Creek in the Chehalis Headwaters), which is expected to more accurately reflect sediment yields for roads built on the lithology found in southwestern Washington (Sullivan and Duncan, 1980) and the Oregon Coast Range. We multiplied the base erosion rate derived for each road segment in the watershed by a factor based on the level of traffic projected for that road segment over the next 5 years. These factors are provided in the standard methodology for no traffic, light, moderate and heavy traffic levels (WFPB 1995). Using the standard methodology, we varied the traffic factors until the results matched the field data for the same set of road segments at Mack Creek. The calibration resulted in traffic factors that are approximately 1/10th of the standard WFPB methodology traffic factors (K. Sullivan and J. Clark, 1996, personal communication).

The analysis of sedimentation in the Siuslaw Watershed Analysis did not make this deviation to the traffic factor (USDI BLM 1996a, pp. II-1 - II-8, III-6). If the total road-related sedimentation calculated in the watershed analysis were assumed to be evenly distributed across the watershed, the planning area portion of the total in the watershed analysis would be 299 cubic yards/year, as compared to the 108 cubic yards/year in our analysis here. This difference is primarily resultant from the deviation in the traffic factor, which is consistent with the field observations in the 2002 road inventory of the planning area. Also, our analysis here assumed that hauling of timber would be done primarily in the summer, in part because thinning operations in most alternatives would be seasonally limited by temporary roads (see Chapter 4 - Introduction).

Furthermore, the 2002 road inventory estimated that the relative contributions to road-related sediment delivery in the planning area are 50% from the tread, 31% from the cut-slope, and 4% from the fill-slope. The Siuslaw Watershed Analysis assumed deliveries of 40% from the tread, 40% from the cut-slope, and 20% from the fill-slope. Finally, of the 24.84 miles of road segments that the 2002 road inventory determined are capable of delivering sediment, approximately 11 miles are paved, and are therefore producing negligible sediment deliveries from the tread. The 2002 road inventory has a high confidence level, because specialists drove each road segment and identified road prism characteristics.

Basic erosion rates established by various researchers reflect the erodibility rates for roads built in different geologic materials (WFPB 1995). The planning area is dominantly composed of sedimentary geology. The rate represents erosion from the bare road prism surfaces. Road surfacing material determines the erodibility of the surface tread during traffic, particularly during heavy haul, and is adjusted according to the type and depth of surfacing material. Typically, roads in the planning area are maintained with a lift of approximately 6" of compacted, fractured gravel, mostly mixed volcanics from local quarries.

## Table 10. Summary of road modeling factors

| GEOLOGY | Parent Rock Code | Erosion Factor (kg/m2) | Ground Cover | | Road Surfacing | | | Road Use | | Traffic Factor | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | Factor | Description | Code | Factor | Type | Code | Heavy* | Mod.* |
| **Mica schist, volcanic ash, highly wx sedimentary, 0-2 year old road.** | 1 | 25.00 | <1% | 1.00 | Native Soil | 1 | 1.00 | Mainline | 1 | 5 | 0.4 |
| **Mica schist, volcanic ash, highly wx sedimentary, >2 year old road.** | 2 | 13.50 | 10% | 0.77 | Soft Rock | 2 | 0.75 | Primary | 2 | 0.4 | 0.4 |
| **Quartzite, coarse-grained granite,0-2 year old road.** | 3 | 25.00 | 20% | 0.63 | Pit Run | 4 | 0.20 | Secondary | 3 | 0.3 | 0.1 |
| **Quartzite, coarse-grained granite, >2 year old road.** | 4 | 7.00 | 30% | 0.53 | Crushed Rock | 5 | 0.50 | Spur | 4 | 0.1 | 0.1 |
| **Fine-grained granite, moderately wx rock, sedimentary rocks, 0-2 year old road.** | 5 | 13.50 | 50% | 0.37 | Vegetation | 6 | 0.75 | | | | |
| **Fine-grained granite, moderately wx rock, sedimentary rocks, >2 year old road.** | 6 | 7.00 | 80% | 0.18 | Paved | 7 | 0.00 | | | | |
| **Competent granite, basalt, meta-morphic rocks, relatively un-weathered rocks, 0-2 year old road.** | 7 | 4.50 | | | | | | | | | |

* Traffic factors recalibrated according to Mack Creek Study, Washington (Kate Sullivan, Jeffrey Clarke, Weyerhaeuser, pers. comm., 1996).

General confidence in assessing the sediment yields of road segments is moderate, although the confidence of the quality of the data collected during the road inventory is high. It is uncertain whether the planning area soils more accurately reflect the western Washington unpublished study or the Idaho Batholith studies from which the Washington Watershed Analysis methods were originally derived. The accuracy of the model reflects the quality of input information. We evaluated the rate of sediment delivery from roads using a model that simplifies a complex road system. Given the limitations in this simple model and the limitations in averaging road prism characteristics, any estimation errors would likely be uniformly applied to all inventoried roads and any errors in scale would not drastically change any of the analytical conclusions.

# Landslides from Culvert Failures

During the 2002 road inventory, we identified 73 culverts that are currently at risk of failure because they are undersized, plugged, currently failing, or poorly engineered (See Table 11). That inventory found that approximately 57 miles of road have a high potential for culvert failure with delivery to streams. Of that total, approximately 26 miles are paved and 31 miles are gravel/dirt. We used only stream-crossing culverts for this quantification.

Calculating the sediment deliver to streams if these culverts were to fail required many simplifying assumptions. We included only the amount of fill calculated to exist around each culvert, and did not attempt to estimate mass wasting from debris flows or any other catastrophic road drainage problem. We assumed that an average width of road prism was 40', because this was most typical length of Siuslaw River BLM culverts (BLM oral communications, 2002); that an 18" culvert has a 4' active channel width, a 24" culvert has a 6' active channel width, a 32" culvert has a 7' active channel width, a 56" culvert has a 12' active channel width, and a 72" culvert has a 20' active channel width. We estimated that the depth of fill * the active channel width * 1.5 (to account for the slope above the culvert failure) * the average road prism width would give an approximate estimate of how much sediment would be delivered to streams if all high-risk culverts were to fail.

Although few studies have been conducted to measure suspended sediment and stream discharge during culvert removals, some monitoring reports do exist. Monitoring results from Quartz Creek, Montana revealed that different equipment operators affect the amount of sediment generated, but that overall in-stream effects are of short duration and do not affect beneficial uses (Wegner 1999). Monitoring results from the Lolo National Forest, Montana, indicate that between 1 to 2 cubic yards were introduced into the stream during and after culvert removal (Lolo, 2000). BLM personal communications, 2002, indicate that little sedimentation has been observed in the past during BLM culvert removals and replacement. The Eugene District uses best management practices such as dewatering, straw bales, and numerous bio-engineering techniques, which reduce sediment production substantially. To quantify sedimentation from culvert removal, we assumed that 1 cubic yard could potentially be delivered to the stream channel during culvert removal and replacement. We assumed that we would remove or replace culverts at an even pace over a ten-year period.

## References

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Washington Forest Practices Board. 1995. Standard Methodology for Conducting Watershed Analysis. Version 3.0.

Wegner S. 1999. Monitoring Results of Watershed Restoration Activities, Quartz Creek, Montana.

## Table 11. Culverts at Risk of Failure

| Road Number | Culvert Fill Feet | CMP* Size Inches | CMP Size Feet | Total Fill Depth Feet | Active Channel Width Feet | Fill Width Feet | Stream Xing | Tread Width Feet | Cubic Feet | Cubic Yards |
|---|---|---|---|---|---|---|---|---|---|---|
| 19-5-22.2 | 13 | 15 | 1.25 | 14.25 | 4 | 6 | x | 40 | 3420 | 127 |
| 19-5-22.2 | 13 | 18 | 1.50 | 1.50 | 4 | 4 | x | 40 | 40 | 40 |
| 19-5-22.2 | 15 | 18 | 1.50 | 16.50 | 4 | 6 | x | 40 | 3960 | 147 |
| 19-6-19 | 4 | 15 | 1.25 | 5.25 | 4 | 6 | x | 40 | 1260 | 47 |
| 19-6-19 | 6 | 20 | 1.67 | 7.67 | 5 | 7.5 | x | 40 | 2300 | 85 |
| 19-6-21.2 | 6 | 18 | 1.50 | 7.50 | 4 | 6 | x | 40 | 1800 | 67 |
| 19-6-28 | 2 | 18 | 1.50 | 3.50 | 4 | 6 | x | 40 | 840 | 31 |
| 19-6-28 | 14 | 18 | 1.50 | 15.50 | 4 | 6 | x | 40 | 3720 | 138 |
| 19-6-28 | 2 | 18 | 1.50 | 3.50 | 4 | 6 | x | 40 | 840 | 31 |
| 19-6-28 | 6 | 18 | 1.50 | 7.50 | 4 | 6 | x | 40 | 1800 | 67 |
| 19-6-28 | 3 | 18 | 1.50 | 4.50 | 4 | 6 | x | 40 | 1080 | 40 |
| 19-6-28 | 7 | 18 | 1.50 | 8.50 | 4 | 6 | x | 40 | 2040 | 76 |
| 19-6-28 | 5 | 18 | 1.50 | 6.50 | 4 | 6 | x | 40 | 1560 | 58 |
| 19-6-29 | 2 | 18 | 1.50 | 3.50 | 4 | 6 | x | 40 | 840 | 31 |
| 19-6-29 | 2 | 18 | 1.50 | 3.50 | 4 | 6 | x | 40 | 840 | 31 |
| 19-6-30 | 10 | 15 | 1.25 | 11.25 | 3 | 4.5 | x | 40 | 2025 | 75 |
| 19-6-30 | 10 | 18 | 1.50 | 11.50 | 4 | 6 | x | 40 | 2760 | 102 |
| 19-6-32.1 | 10 | log | 0.00 | 10.00 |  | 0 | x | 40 | 0 | 0 |
| 19-7-35 | 8 | 18 | 1.50 | 9.50 | 4 | 6 | x | 40 | 2280 | 84 |
| 19-7-35 | 5 | 18 | 1.50 | 6.50 | 4 | 6 | x | 40 | 1560 | 58 |
| 19-7-35 | 3 | 18 | 1.50 | 4.50 | 4 | 6 | x | 40 | 1080 | 40 |
| 19-7-35 | 3 | 18 | 1.50 | 4.50 | 4 | 6 | x | 40 | 1080 | 40 |
| 19-7-35 | 3 | 18 | 1.50 | 4.50 | 4 | 6 | x | 40 | 1080 | 40 |
| 19-7-35 | 5 | 18 | 1.50 | 6.50 | 4 | 6 | x | 40 | 1560 | 58 |
| 19-7-35.1 | 15 | 15 | 1.25 | 16.25 | 3 | 4.5 | x | 40 | 2925 | 108 |
| 19-7-35.1 | 20 | 15 | 1.25 | 21.25 | 3 | 4.5 | x | 40 | 3825 | 142 |
| 19-7-35.1 | 20 | 15 | 1.25 | 21.25 | 3 | 4.5 | x | 40 | 3825 | 142 |
| 20-5-14.1 | 10 | 18 | 1.50 | 11.50 | 4 | 6 | x | 40 | 2760 | 102 |
| 20-5-14.1 | 7 | 15 | 1.25 | 8.25 | 3 | 4.5 | x | 40 | 1485 | 55 |
| 20-5-14.1 | 5 | 15 | 1.25 | 6.25 | 3 | 4.5 | x | 40 | 1125 | 42 |
| 20-5-14.1 | 4 | 18 | 1.50 | 5.50 | 4 | 6 | x | 40 | 1320 | 49 |
| 20-5-23 | 12 | log | 0.00 | 12.00 |  | 0 | x | 40 | 0 | 0 |
| 20-5-23 | 15 | log | 0.00 | 15.00 |  | 0 | x | 40 | 0 | 0 |
| 20-5-23 | 20 | log | 0.00 | 20.00 |  | 0 | x | 40 | 0 | 0 |
| 20-5-35.7 | 17 | log | 0.00 | 17.00 |  | 0 | x | 40 | 0 | 0 |
| 20-6-4.2 | 8 | 18 | 1.50 | 9.50 | 4 | 6 | x | 40 | 2280 | 84 |
| 20-6-4.2 | 6 | 15 | 1.25 | 7.25 | 3 | 4.5 | x | 40 | 1305 | 48 |
| 20-6-4.3 | 18 | 18 | 1.50 | 19.50 | 4 | 6 | x | 40 | 4680 | 173 |
| 20-6-4.3 | 13 | 18 | 1.50 | 14.50 | 4 | 6 | x | 40 | 3480 | 129 |
| 20-6-5 | 6 | 18 | 1.50 | 7.50 | 4 | 6 | x | 40 | 1800 | 67 |
| 20-6-5 | 8 | 18 | 1.50 | 9.50 | 4 | 6 | x | 40 | 2280 | 84 |
| 20-6-9 | 4 | 18 | 1.50 | 5.50 | 4 | 6 | x | 40 | 1320 | 49 |
| 20-6-9 | 3 | 18 | 1.50 | 4.50 | 4 | 6 | x | 40 | 1080 | 40 |
| 20-6-9 | 4 | 18 | 1.50 | 5.50 | 4 | 6 | x | 40 | 1320 | 49 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **20-6-10** | 14 | 24 | 2.00 | 16.00 | 6 | 9 | x | 40 | 5760 | 213 |
| **20-6-10.4** | 12 | 15 | 1.25 | 13.25 | 3 | 4.5 | x | 40 | 2385 | 88 |
| **20-6-10.4** | 12 | 18 | 1.50 | 13.50 | 4 | 6 | x | 40 | 3240 | 120 |
| **20-6-11** | 2 | 18 | 1.50 | 3.50 | 4 | 6 | x | 40 | 840 | 31 |
| **20-6-11** | 4 | 12 | 1.00 | 5.00 | 3 | 4.5 | x | 40 | 900 | 33 |
| **20-6-11** | 5 | 18 | 1.50 | 6.50 | 4 | 6 | x | 40 | 1560 | 58 |
| **20-6-11** | 5 | 18 | 1.50 | 6.50 | 4 | 6 | x | 40 | 1560 | 58 |
| **20-6-11** | 6 | 18 | 1.50 | 7.50 | 4 | 6 | x | 40 | 1800 | 67 |
| **20-6-11** | 4 | 18 | 1.50 | 5.50 | 4 | 6 | x | 40 | 1320 | 49 |
| **20-6-11** | 7 | 18 | 1.50 | 8.50 | 4 | 6 | x | 40 | 2040 | 76 |
| **20-6-11** | 6 | 72 | 6.00 | 12.00 | 20 | 30 | x | 40 | 14400 | 533 |
| **20-6-11** | 3 | 18 | 1.50 | 4.50 | 4 | 6 | x | 40 | 1080 | 40 |
| **20-6-11** | 11 | 18 | 1.50 | 12.50 | 4 | 6 | x | 40 | 3000 | 111 |
| **20-6-11** | 4 | 24 | 2.00 | 6.00 | 6 | 9 | x | 40 | 2160 | 80 |
| **20-6-11** | 4 | 54 | 4.50 | 8.50 | 12 | 18 | x | 40 | 6120 | 227 |
| **20-6-11** | 6 | 24 | 2.00 | 8.00 | 6 | 9 | x | 40 | 2880 | 107 |
| **20-6-13** | 2 | 18 | 1.50 | 3.50 | 4 | 6 | x | 40 | 840 | 31 |
| **20-6-13.2** | 2 | 18 | 1.50 | 3.50 | 4 | 6 | x | 40 | 840 | 31 |
| **20-6-13.3** | 7 | 18 | 1.50 | 8.50 | 4 | 6 | x | 40 | 2040 | 76 |
| **20-6-13.3** | 15 | 18 | 1.50 | 16.50 | 4 | 6 | x | 40 | 3960 | 147 |
| **20-6-13.3** | 15 | 18 | 1.50 | 16.50 | 4 | 6 | x | 40 | 3960 | 147 |
| **20-6-13.3** | 12 | 15 | 1.25 | 1.25 | 3 | 3 | x | 40 | 40 | 40 |
| **20-6-21.1** | 10 | 32 | 2.67 | 12.67 | 7 | 10.5 | x | 40 | 5320 | 197 |
| **20-6-21.1** | 8 | 24 | 2.00 | 10.00 | 6 | 9 | x | 40 | 3600 | 133 |
| **20-6-21.1** | 9 | 28 | 2.33 | 11.33 | 6 | 9 | x | 40 | 4080 | 151 |
| **20-6-21.1** | 25 | 56 | 4.67 | 29.67 | 12 | 18 | x | 40 | 21360 | 791 |
| **20-6-21.1** | 17 | 18 | 1.50 | 18.50 | 4 | 6 | x | 40 | 4440 | 164 |
| **20-6-21.1** | 15 | 24 | 1.25 | 16.25 | 6 | 9 | x | 40 | 5850 | 217 |
| | | | | | | | | | **TOTAL** | 6891 |

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* CMP - corrugated metal pipe

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# APPENDIX E
# Roads Decommissioning By Alternative

The following tables list the roads and mileages that would be decommissioned under each alternative and as referenced in Appendix A. The roads listed in the tables are illustrated on the maps presented in Chapter 4. If discrepancies are found between the maps and the tables, the tables will be considered the controlling source.

**Table 12. Roads being passively decommissioned**

| Road No. | Length | Road No. | Length |
|---|---|---|---|
| 19-5-31.71 | 0.17 | 20-6-9.72 | 0.07 |
| 19-5-31.72 | 0.12 | 20-6-9.73 | 0.07 |
| 19-5-33 | 1.06 | 20-6-10.2 | 0.83 |
| 19-6-27.6 | 0.06 | 20-6-10.4B | 0.75 |
| 19-6-27.72 | 0.32 | 20-6-17.2 | 0.13 |
| 19-6-27.73 | 0.38 | 20-6-17.71 | 0.06 |
| 19-6-31.71 | 0.06 | 20-6-19.4 | 0.08 |
| 19-6-31.73 | 0.29 | 20-6-23.72 | 0.18 |
| 19-6-33.1 | 0.29 | 20-7-1.71 | 0.26 |
| 19-6-35.1 | 0.17 | 20-7-3.3 | 0.25 |
| 19-6-35.3 | 0.11 | 20-7-3.5 | 0.40 |
| 19-6-35.4 | 0.09 | 20-7-3.71 | 0.13 |
| 19-7-35B | 0.92 | 20-7-3.72 | 0.10 |
| 20-5-7A | 0.50 | 20-7-13.71 | 0.25 |
| 20-5-7.1A | 0.25 | 20-7-14.71 | 0.09 |
| 20-5-7.71 | 0.42 | 20-7-15 | 0.16 |
| 20-5-7.72 | 0.71 | 20-7-16.1B3 | 0.17 |
| 20-6-7.71 | 0.11 | 20-7-16.2 | 0.46 |
| 20-6-8.2 | 0.33 | | |

**Table 13. Sediment Delivery Roads (should be included for decommissioning in all action alternatives) All Alternatives**

| Road No. | Length |
|---|---:|
| 19-6-19 | 0.72 |
| 19-6-20.1B | 0.82 |
| 19-6-21.1 | 0.21 |
| 19-6-27.2 | 0.42 |
| 19-6-27.5 | 1.00 |
| 19-6-28A | 0.79 |
| 19-6-28B | 0.28 |
| 19-6-30 | 1.68 |
| 19-6-32.1B | 0.21 |
| 19-6-35.7 | 0.54 |
| 20-5-18.2D | 0.54 |
| 20-5-18.4B | 0.27 |
| 20-5-31C | 1.26 |
| 20-520-6-1 | 1.25 |
| 20-5-4.3B | 0.43 |
| 20-5-5.3 | 0.30 |
| 20-5-11E | 1.45 |
| 20-5-11F | 0.25 |
| 20-5-13.3B | 1.29 |

**Table 14. Roads to be Decommissioned**
**(does not include passively decommissioned roads)**
**Alternative B**

| Road No. | Length | Public Access (Y/N) | Comments |
|---|---|---|---|
| 19-5-19.71 | 0.09 | N | |
| 19-5-22.2D | 1.92 | N | |
| 19-5-29C | 0.35 | N | |
| 19-5-30.2B | 0.07 | N | |
| 19-5-30.4 | 0.23 | N | |
| 19-5-31.1 | 0.52 | N | |
| 19-5-31.3 | 0.21 | N | |
| 19-5-33.1 | 0.30 | Y | |
| 19-5-33.2 | 0.32 | Y | |
| 19-5-33.3A | 0.13 | Y | |
| 19-5-33.3B | 0.20 | Y | |
| 19-5-33.4 | 0.06 | Y | |
| 19-5-33.71 | 0.41 | N | |
| 19-5-33.72 | 0.17 | Y | |
| 19-6-15.6 | 0.30 | Y | |
| 19-6-17.71 | 0.61 | N | |
| 19-6-17.72 | 0.08 | N | |
| 19-6-17.73 | 0.06 | N | |
| 19-6-18B | 0.18 | N | |
| 19-6-18C1 | 0.39 | N | |
| 19-6-18C2 | 0.38 | N | |
| 19-6-18.8 | 0.15 | N | |
| 19-6-18.9 | 0.16 | Y | |
| 19-6-18.1 | 0.30 | N | |
| 19-6-19 | 0.72 | N | |
| 19-6-19.1 | 0.21 | N | |
| 19-6-19.2 | 0.09 | N | |
| 19-6-19.3 | 0.16 | N | |
| 19-6-19.4 | 0.17 | Y | |
| 19-6-20.1B | 0.82 | N | |
| 19-6-21.1 | 0.21 | N | |
| 19-6-21.2 | 0.68 | N | |
| 19-6-21.3 | 0.28 | N | |
| 19-6-21.4 | 0.20 | N | |
| 19-6-21.5 | 0.19 | N | |
| 19-6-21.6 | 0.12 | N | |
| 19-6-23.3 | 0.23 | N | |
| 19-6-23.4 | 0.16 | N | |
| 19-6-25 | 1.14 | Y | |

## Table 14. Roads to be Decommissioned
**(does not include passively decommissioned roads)**
**Alternative B**

| | | | |
|---|---|---|---|
| 19-6-25.71 | 1.06 | Y | |
| 19-6-25.72 | 0.23 | Y | |
| 19-6-25.73 | 0.07 | Y | |
| 19-6-26B | 0.15 | N | |
| 19-6-27 | 0.91 | N | |
| 19-6-27.1 | 0.65 | Y | |
| 19-6-27.2 | 0.42 | Y | |
| 19-6-27.3 | 0.15 | N | |
| 19-6-27.4 | 0.04 | N | |
| 19-6-27.5 | 1.00 | Y | |
| 19-6-27.7 | 0.27 | N | |
| 19-6-27.71 | 0.17 | N | |
| 19-6-28A | 0.79 | Y | |
| 19-6-28B | 0.28 | Y | |
| 19-6-28.2B | 1.04 | N | |
| 19-6-28.3 | 0.31 | N | |
| 19-6-28.4 | 0.39 | N | |
| 19-6-29.5 | 0.25 | N | |
| 19-6-29.6 | 0.14 | N | |
| 19-6-30 | 1.68 | N | |
| 19-6-31.72 | 0.10 | N | |
| 19-6-32.1B | 0.21 | N | |
| 19-6-33 | 1.30 | Y | |
| 19-6-33.2 | 0.18 | Y | |
| 19-6-33.3 | 0.27 | Y | |
| 19-6-34.1 | 0.14 | N | |
| 19-6-35.2 | 0.23 | Y | |
| 19-6-35.5 | 0.55 | Y | |
| 19-6-35.6A | 0.21 | Y | |
| 19-6-35.7 | 0.54 | Y | |
| 19-6-35.8 | 0.70 | Y | |
| 19-6-35.9 | 0.04 | Y | |
| 19-6-35.1 | 0.11 | Y | |
| 19-7-13.1 | 0.20 | N | |
| 19-7-13.2 | 0.32 | N | |
| 19-7-14.6B | 0.42 | N | |
| 19-7-14.7B | 0.41 | N | |
| 19-7-23.2 | 0.40 | N | |
| 19-7-26B | 0.19 | N | |
| 19-7-26C | 0.17 | N | |

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## Table 14. Roads to be Decommissioned

**(does not include passively decommissioned roads)**
**Alternative B**

| | | | |
|---|---|---|---|
| 19-7-26D | 0.14 | N | |
| 19-7-36B2 | 0.10 | N | |
| 19-7-36.3 | 0.53 | N | |
| 19-7-36.8B | 0.43 | N | |
| 20-5-5A | 0.30 | N | |
| 20-5-5.1 | 0.76 | Y | |
| 20-5-17.71 | 0.63 | N | |
| 20-5-17.72 | 0.57 | N | |
| 20-5-17.73 | 0.21 | N | |
| 20-5-18B | 0.80 | N | |
| 20-5-18.2D | 0.54 | N | |
| 20-5-18.4B | 0.27 | N | |
| 20-5-19 | 0.76 | N | |
| 20-5-19.1 | 0.08 | N | |
| 20-5-19.2A | 0.37 | N | |
| 20-5-19.3 | 0.43 | N | |
| 20-5-19.4 | 0.24 | N | |
| 20-5-20.1A | 0.09 | N | |
| 20-5-20.1B | 1.35 | N | |
| 20-5-20.1C | 0.30 | N | |
| 20-5-20.2 | 0.26 | N | |
| 20-5-21.1G | 0.67 | N | |
| 20-5-21.4 | 0.05 | N | |
| 20-5-21.5 | 0.05 | N | |
| 20-5-27.5D | 0.64 | N | |
| 20-5-28B | 1.18 | N | |
| 20-5-28D | 0.05 | N | |
| 20-5-28.1 | 0.26 | N | |
| 20-5-29.1 | 0.61 | N | |
| 20-5-29.2 | 0.09 | N | |
| 20-5-31C | 1.26 | N | |
| 20-5-31.2 | 0.46 | Y | |
| 20-5-31.3 | 0.14 | Y | |
| 20-5-31.4 | 0.39 | Y | |
| 20-5-33 | 0.68 | Y | |
| 20-5-33.1 | 0.16 | N | |
| 20-5-33.2 | 0.16 | Y | |
| 20-5-33.3 | 0.27 | Y | |
| 20-5-33.4 | 0.17 | Y | |
| 20-5-33.71 | 0.31 | Y | |

## Table 14. Roads to be Decommissioned
**(does not include passively decommissioned roads)**
**Alternative B**

| | | | |
|---|---|---|---|
| 20-5-33.72 | 0.08 | Y | |
| 20-5-34.2C | 0.23 | N | |
| 20-534.3 | 0.16 | N | |
| 20-5-34.4 | 0.12 | N | |
| 20-6-1 | 1.25 | Y | |
| 20-6-1.71 | 0.06 | Y | |
| 20-6-2B2 | 0.51 | N | |
| 20-6-3C | 0.54 | N | |
| 20-6-3.1 | 0.49 | N | |
| 20-6-3.2 | 0.25 | N | |
| 20-6-3.3A | 0.11 | N | |
| 20-6-3.3B | 0.06 | N | |
| 20-6-4.3B | 0.43 | N | |
| 20-6-4.5 | 0.43 | N | |
| 20-6-4.6 | 0.48 | N | |
| 20-6-5.3 | 0.30 | N | |
| 20-6-5.4 | 0.26 | N | |
| 20-6-5.5 | 0.32 | N | |
| 20-6-6.1B | 0.12 | N | |
| 20-6-9.1B | 1.01 | N | |
| 20-6-9.3 | 0.11 | N | |
| 20-6-9.4 | 0.13 | N | |
| 20-6-9.71 | 0.15 | N | |
| 20-6-11E | 1.45 | Y | |
| 20-6-11F | 0.25 | Y | |
| 20-6-12E | 0.31 | N | |
| 20-6-12.1C | 0.70 | N | |
| 20-6-13A3 | 0.14 | N | |
| 20-6-13B | 0.60 | Y | |
| 20-6-13C | 0.55 | Y | |
| 20-6-13.1A | 0.62 | Y | |
| 20-6-13.1B | 0.58 | Y | |
| 20-6-13.1C | 0.12 | Y | |
| 20-6-13.3B | 1.29 | N | that part past the -23.71 road |
| 20-6-13.5A | 0.21 | N | |
| 20-6-13.5B | 0.29 | N | |
| 20-6-13.6 | 0.34 | Y | |
| 20-6-14.1B | 0.34 | N | |
| 20-6-14.2 | 0.85 | N | |
| 20-6-15.2 | 0.13 | Y | |

## Table 14. Roads to be Decommissioned
**(does not include passively decommissioned roads)**
**Alternative B**

| | | | |
|---|---|---|---|
| 20-6-15.3 | 0.07 | Y | |
| 20-6-15.71 | 0.19 | Y | |
| 20-6-15.72 | 0.26 | Y | |
| 20-6-17.4 | 0.20 | Y | |
| 20-6-17.72 | 0.11 | N | |
| 20-6-18.2C | 0.30 | N | |
| 20-6-18.3 | 0.71 | N | |
| 20-6-18.4C | 0.35 | N | |
| 20-6-19.1 | 0.45 | Y | |
| 20-6-19.2 | 0.06 | Y | |
| 20-6-19.3 | 0.30 | Y | |
| 20-6-20D | 0.67 | N | |
| 20-6-20.2 | 0.37 | Y | |
| 20-6-20.4 | 0.18 | N | |
| 20-6-20.5 | 0.31 | Y | |
| 20-6-21.2 | 0.46 | Y | |
| 20-6-21.3 | 0.10 | Y | |
| 20-6-23.1 | 0.56 | N | |
| 20-6-23.2 | 0.08 | N | |
| 20-6-29 | 0.45 | Y | |
| 20-6-29.1 | 0.09 | Y | |
| 20-6-29.2 | 0.06 | Y | |
| 20-7-1 | 0.33 | N | |
| 20-7-1.1 | 0.45 | N | |
| 20-7-2B | 0.76 | N | |
| 20-7-4.2 | 0.75 | N | |
| 20-7-10 | 1.25 | N | that part past the jct with the -3.4 road |
| 20-7-11.2 | 0.14 | N | |
| 20-7-11.3 | 0.42 | N | |
| 20-7-11.71 | 0.35 | N | |
| 20-7-12 | 0.30 | N | |
| 20-7-14.1 | 0.32 | N | |
| 20-7-14.2 | 0.68 | N | |
| 20-7-14.3 | 0.08 | N | |
| 20-7-15.71 | 0.09 | N | |

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## Table 15. Roads to be Decommissioned
**(does not include passively decommissioned roads)**
**Alternatives C and F**

| Road No. | Length | Public Access (Y/N) | Comments |
|---|---|---|---|
| 19-6-19 | 0.72 | N | |
| 19-6-19.1 | 0.21 | N | |
| 19-6-19.2 | 0.09 | N | |
| 19-6-19.3 | 0.16 | N | |
| 19-6-20.1B | 0.82 | N | |
| 19-6-21.1 | 0.21 | N | |
| 19-6-23.4 | 0.16 | N | |
| 19-6-25 | 1.14 | Y | |
| 19-6-25.71 | 1.06 | Y | |
| 19-6-25.72 | 0.23 | Y | |
| 19-6-25.73 | 0.07 | Y | |
| 19-6-27.2 | 0.42 | Y | |
| 19-6-27.5 | 1.00 | Y | |
| 19-6-28A | 0.79 | N | |
| 19-6-28B | 0.28 | N | |
| 19-6-30 | 1.68 | N | |
| 19-6-31.72 | 0.10 | N | |
| 19-6-32.1B | 0.21 | N | |
| 19-6-35.5 | 0.55 | Y | |
| 19-6-35.6 | 0.21 | Y | |
| 19-6-35.7 | 0.54 | N | |
| 20-5-17.71 | 0.63 | N | |
| 20-5-17.72 | 0.57 | N | |
| 20-5-17.73 | 0.21 | N | |
| 20-5-18.2D | 0.54 | N | |
| 20-5-18.4B | 0.27 | N | |
| 20-5-19.2A | 0.37 | N | |
| 20-5-20.1A | 0.09 | N | |
| 20-5-20.1B | 1.35 | N | |
| 20-5-20.1C | 0.30 | N | |
| 20-5-31C | 1.26 | N | |
| 20-6-1 | 1.25 | N | |
| 20-6-4.3B | 0.43 | N | |
| 20-6-5.3 | 0.30 | N | |
| 20-6-6.1B | 0.12 | N | |
| 20-6-11E | 1.45 | Y | |
| 20-6-11F | 0.25 | Y | |
| 20-6-13.3B | 1.29 | N | that part past the jct with helipond road |
| 20-6-23.1 | 0.56 | N | |
| 20-7-2B | 0.76 | N | |
| 20-7-14.2 | 0.68 | N | |
| 20-7-14.3 | 0.08 | N | |

### Table 16. Roads to be Decommissioned
**(does not include passively decommissioned roads) Alternatives D and E**

| Road No. | Length | Public Access (Y/N) | Comments |
|---|---:|:---:|---|
| 19-5-19.71 | 0.09 | N | |
| 19-5-22.2D | 1.92 | N | |
| 19-5-29C | 0.35 | N | |
| 19-5-29D | 0.39 | N | |
| 19-5-31.1 | 0.52 | N | |
| 19-5-31.3 | 0.21 | N | |
| 19-5-33.2 | 0.32 | Y | |
| 19-5-33.3A | 0.13 | Y | |
| 19-5-33.3B | 0.20 | Y | |
| 19-5-33.4 | 0.06 | Y | |
| 19-5-33.72 | 0.17 | Y | |
| 19-6-17.71 | 0.61 | N | |
| 19-6-17.72 | 0.08 | N | |
| 19-6-17.73 | 0.06 | N | |
| 19-6-19 | 0.72 | N | |
| 19-6-19.1 | 0.21 | N | |
| 19-6-19.2 | 0.09 | N | |
| 19-6-19.3 | 0.16 | N | |
| 19-6-20.1B | 0.82 | N | |
| 19-6-21.1 | 0.21 | N | |
| 19-6-21.2 | 0.68 | N | |
| 19-6-21.5 | 0.19 | N | |
| 19-6-23.3 | 0.23 | N | |
| 19-6-23.4 | 0.16 | N | |
| 19-6-25 | 1.14 | Y | |
| 19-6-25.71 | 1.06 | Y | |
| 19-6-25.72 | 0.23 | Y | |
| 19-6-25.73 | 0.07 | Y | |
| 19-6-27.1 | 0.65 | Y | |
| 19-6-27.2 | 0.42 | Y | |
| 19-6-27.5 | 1.00 | Y | |
| 19-6-28A | 0.79 | Y | |
| 19-6-28B | 0.28 | Y | |
| 19-6-28.2B | 0.50 | N | |
| 19-6-28.3 | 0.31 | N | |
| 19-6-30 | 1.68 | N | |
| 19-6-31.72 | 0.10 | N | |
| 19-6-32.1B | 0.21 | N | |
| 19-6-33 | 0.25 | Y | that part past jct with -33.3 road |
| 19-6-35.2 | 0.23 | Y | |
| 19-6-35.5 | 0.55 | Y | |
| 19-6-35.6A | 0.21 | Y | |
| 19-6-35.7 | 0.54 | Y | |
| 19-6-35.8 | 0.70 | Y | |
| 19-6-35.9 | 0.04 | Y | |
| 19-7-36.8B | 0.43 | N | |
| 20-5-5.1 | 0.76 | Y | |

## Table 16. Roads to be Decommissioned
**(does not include passively decommissioned roads) Alternatives D and E**

| | | | |
|---|---|---|---|
| 20-5-17.71 | 0.63 | N | |
| 20-5-17.72 | 0.57 | N | |
| 20-5-17.73 | 0.21 | N | |
| 20-5-18.2D | 0.54 | N | |
| 20-5-18.4B | 0.27 | N | |
| 20-5-19.2A | 0.37 | N | |
| 20-5-19.3 | 0.46 | N | |
| 20-5-20.1A | 0.09 | N | |
| 20-5-20.1B | 1.35 | N | |
| 20-5-20.1C | 0.30 | N | |
| 20-5-28B | 1.18 | N | |
| 20-5-28D | 0.05 | N | |
| 20-5-31C | 1.26 | Y | |
| 20-5-31.2 | 0.46 | Y | |
| 20-5-31.3 | 0.14 | Y | |
| 20-5-31.4 | 0.39 | Y | |
| 20-5-33.1 | 0.16 | N | |
| 20-5-33.3 | 0.27 | Y | |
| 20-6-1 | 1.25 | Y | |
| 20-6-1.71 | 0.06 | Y | |
| 20-6-3.1 | 0.49 | N | |
| 20-6-3.2 | 0.25 | N | |
| 20-6-4.3B | 0.43 | N | |
| 20-6-4.5 | 0.43 | N | |
| 20-6-5.3 | 0.30 | N | |
| 20-6-5.4 | 0.26 | N | |
| 20-6-6.1B | 0.12 | N | |
| 20-6-9.1B | 1.01 | N | |
| 20-6-9.71 | 0.15 | N | |
| 20-6-11E | 1.45 | N | |
| 20-6-11F | 0.25 | N | |
| 20-6-12E | 0.31 | N | |
| 20-6-13.3B | 1.29 | N | that part past jct with helipond road |
| 20-6-14.1 | 0.34 | N | |
| 20-6-14.2 | 0.85 | N | |
| 20-6-15.2 | 0.13 | N | |
| 20-6-18.2C | 0.30 | N | |
| 20-6-18.3 | 0.71 | N | |
| 20-6-19.3 | 0.30 | N | |
| 20-6-20.2D | 0.37 | N | |
| 20-6-23.1 | 0.56 | N | |
| 20-7-1 | 0.33 | N | |
| 20-7-2B | 0.76 | N | |
| 20-7-11.3 | 0.42 | N | |
| 20-7-12.3B | 0.33 | N | |
| 20-7-14.2 | 0.68 | N | past the jct with the -14.3 road |
| 20-7-15.71 | 0.09 | N | |

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